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COLLEGE OF MEDICINE
CHICAGO

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VOLUME III.

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THE USE OF BOILED BEEF-BONE INTRAMEDULLARY PEGS IN THE FRACTURES OF LONG BONES

An Experimental Study

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THE USE OF BOILED BEEF-BONE INTRAMEDULLARY PEGS IN THE FRACTURES OF LONG BONES

AN EXPERIMENTAL STUDY[1]

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IN the hope that further light might be shed upon the desirability or the undesirability of the use of boiled beef bone as an internal splint in fractures, a study of the fate of the intramedullary boiled beef-bone peg in recent fractures in dogs was made in the experiments which follow.

A standard operation was determined upon. In the earlier cases the dogs were shaved the day before the operation and a wet, very dilute bichloride dressing was applied. Later, this was abandoned as it was felt that the prevention of infections was dependent entirely upon the care with which the preparation was done at the time of the operation, and the technique of the operation itself.

The operations, with the exception of the first few, were done under the most favorable circumstances. A hospital operating room was placed at our disposal with full complement of internes and nurses, and the same technique, or if anything a more painstaking one, as employed in human beings was used.

After completely anæsthetizing the animal with ether, the upper arm and shoulder were widely shaved and dried with alcohol and ether, and painted with full strength tincture of iodine. The animal was then draped. A longitudinal incision was made over the upper arm and the muscles retracted, care being taken not to injure the musculospiral nerve.

After the humerus had been exposed for a distance of 2 to 3 centimeters, a Gigli saw was passed under it, and the bone was sawed through at right angles to its axis. The two sawed ends of the humerus were brought up into the wound and the marrow cavity was lightly curretted out. A beef-bone peg, which had been boiled for at least 2 hours, was selected of such size as to fit tightly into the marrow cavity. It was thought best in the latter two-thirds of the experiments to use rectangular pegs in the round medullary cavity. By this arrangement there were four points of contact of the peg with the internal circumference of the bone, and the intervening areas of the endosteum were not subjected to any pressure (Fig. B).

The length of each peg was at least twice the width of the bone into which it was inserted. After both fragments were slipped over the peg and approximated, the fractured bone was held together stiffly and rigidly. The muscles and subcutaneous tissue were approximated and the skin closure was carefully done.

Collodion was painted over the wound, and after a dressing was applied a snug plaster cast was put on so as to include the neck, shoulder, back, and the entire arm except the paw. These casts were generally removed at the eighth week, and the animals were killed by ether at the desired dates.

The following are typical case histories in dogs which did not die of early infection.

Dog 6. Operation November 26, 1920. Large dog. Preparation: Shave and iodine at the time of operation. Typical operation. December 14, 1920, abrasion under the left arm has become infected and the constricting area of plaster cut away. Dog otherwise healthy. January 3, 1921, the superficial abrasions caused by the cast have become numerous and badly infected so that the hair is soaked with ill smelling pus and the cast has become softened. The cast is therefore removed on this day, the thirty-eighth postoperative. Palpation of the arm at the site of the fracture showed crepitus and abnormal mobility. As it seemed to be unwise to put on an-

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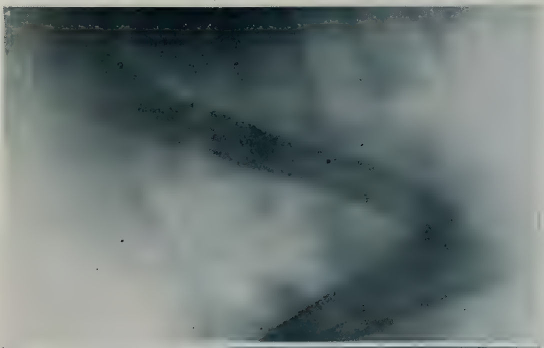
[1] From the Laboratories of University of Illinois College of Medicine and the University Hospital.



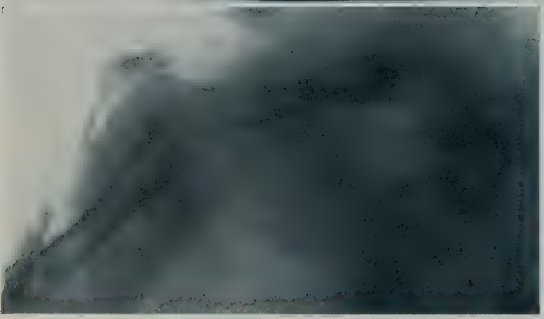
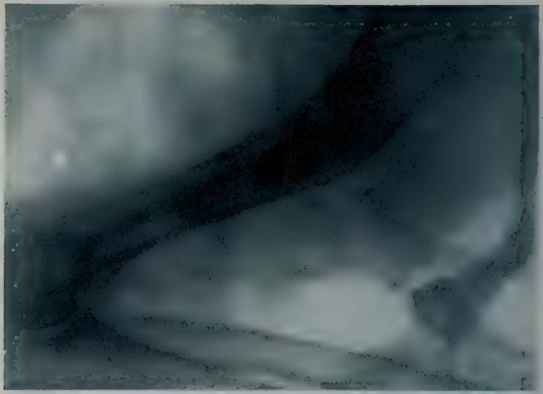
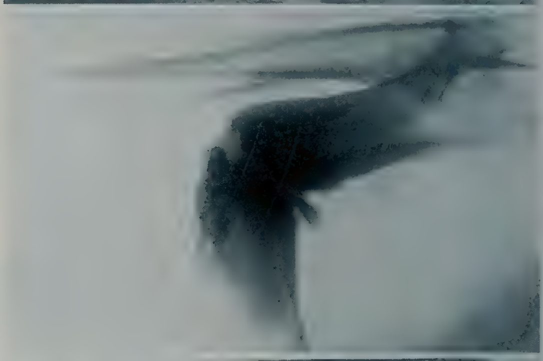


Fig. 1 (above). Dog 5. Roentgenogram 4 days after operation. Boiled beef-bone peg in place in medullary cavity.

Fig. 2. Dog 8. Roentgenogram 5 days after operation. Shows boiled beef bone in place.





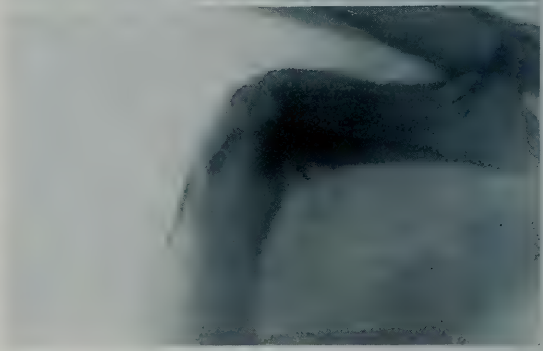


Fig. 3 (upper). Dog 12. Roentgenogram 3 days after operation. Shows fracture splinted by three boiled beef-bone intramedullary pegs.

Fig. 4 (middle). Dog 12. Roentgenogram 284 days after operation. Shaft angulated to nearly 90 degrees. Fragments of the pegs may be seen in each end of the fragments.

Fig. 5 (lower). Dog 12. Roentgenogram 377 days after operation. Firm union at the site of the fracture.

other cast or to let the dog be without one, it was killed by ether. The humerus was disarticulated and removed in one piece to facilitate examination. At the site of the fracture there was a marked proliferation of dense connective tissue which formed a fibrous capsule over the two ends of the live bone. As there was considerable motion at the site of the fracture this connective tissue acted as the capsule of a false joint. About 1 centimeter from the fracture on the distal fragment was a tough projection on the bone measuring 0.3 centimeter by 0.3 centimeter by 1 centimeter and which was composed of connective tissue with probably some early bone formation. On cutting open the fibrous capsule at the fracture the boiled beef-bone peg was found to be firmly embedded in the distal fragment (doubtless the one into which it had been driven at the time of the operation). The upper end of the peg moved about freely in the marrow cavity of the proximal fragment, which marrow cavity had been eroded away so that its internal diameter was greater than it was at the time of the operation. The distal fragment and the attached bone peg were sawed through longitudinally, and the peg was seen to extend well into the cancellous part of the bone. It was in intimate contact with the marrow along its entire extent. Macroscopically there had been no absorption of the peg.

Dog 8. Operation December 10, 1920. Small black and tan dog. Preparation: On the day preceding the operation this dog was shaved and a wet bichloride dressing was applied. Typical operation. Dog well on January 3, 1921. February 7, 1921, dog died following a week's illness which was characterized by coughing and vomiting—fifty-ninth day postoperative. On removing the cast, the humerus was found to be bent to an angle of about 45 degrees and apparently was firmly united. Dissection, how-

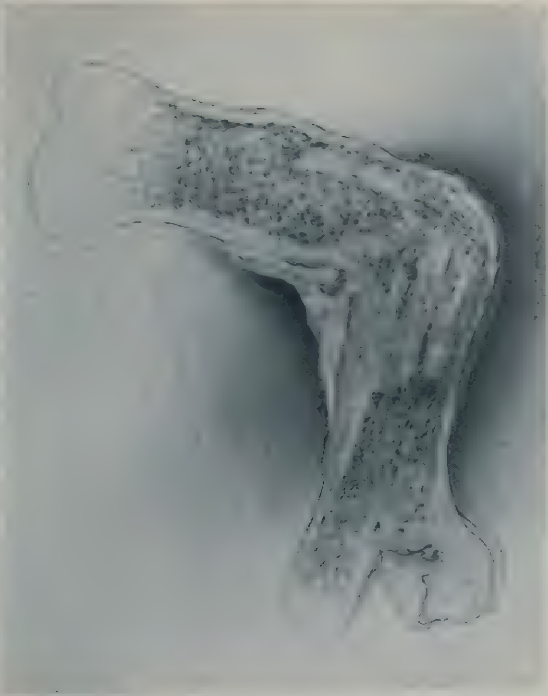
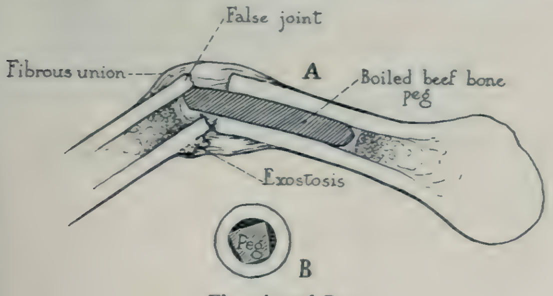


Fig. 6. Dog 12. Appearance of cross section at death, 413 days after operation. Note remnants of boiled beef-bone pegs which almost have been absorbed.

ever, showed that there was a large amount of callus formation and fibrous union and that there was actually a slight amount of motion at the site of the fracture. The specimen was sawed through longitudinally and it was found that the bone peg had slipped out of its engagement in the upper fragment and in resting against the cortical margin of that fragment had formed a false joint there. There was no evidence of union between the peg and the upper fragment. The peg was firmly embedded into the lower fragment (Figure A) and macroscopically there was clear line of demarcation between the peg and adjacent marrow.

Dog 11. Operation, December 30, 1920. Small black and tan dog. Preparation: Shaved the same morning as the operation and skin painted with iodine at the time of the operation. In this case the humerus was fractured by means of a bone cutter instead of by the Gigli saw. As a consequence about 2 centimeters of the side of the distal fragment was broken off, the part broken out being from the bone adjacent to the main fracture. The peg was inserted with great difficulty and when in place was not very secure. After the operation the dog was unable to extend the paw of the affected arm, and the dorsum of this paw had become worn, sore, and free from hair. This was taken to be evidence that the musculospiral nerve had been injured. March 1, 1921, cast cut away from an infected wound of the forearm. March 8, 1921, dog well. March 22, cast removed. A severe infection of the chest wall had occurred under the cast. There was no union at the site of the fracture. March 23, dog died, presumably from the infection of the chest wall. The bone fragments were found to have become disengaged. There was a firm fibrous union. The bone peg was firmly united to one fragment. There was muscular and fibrous attachment to the bone peg.



Figs. A and B

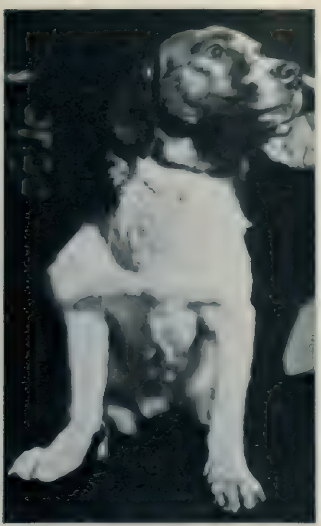


Fig. 7. Dog 12. Photograph taken just before death, 413 days after operation. Shows angular union of right humerus.

Dog 12. Operation, January 7, 1921. Large St. Bernard puppy weighing about 60 pounds. Preparation: Shaved about 2 days previously and wet bichloride dressing applied. The operation was the usual one save that the marrow cavity was so large that it required three large bone pegs to fill it. On February 4, 1921, it was noticed that the dog had eaten through the cast so that it offered no support to the fracture. The cast was accordingly removed. It was found that there was an angulation at the site of the fracture of about 45 degrees and that on palpation a very faint crepitus or gritting could be made out. The dog is in excellent general

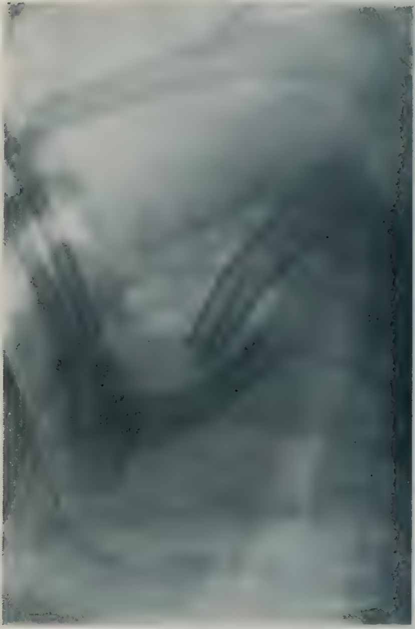


Fig. 8

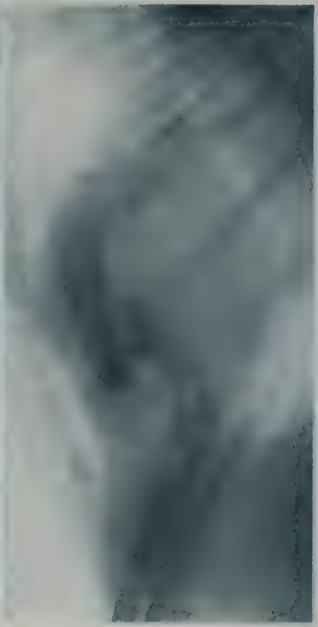


Fig. 9

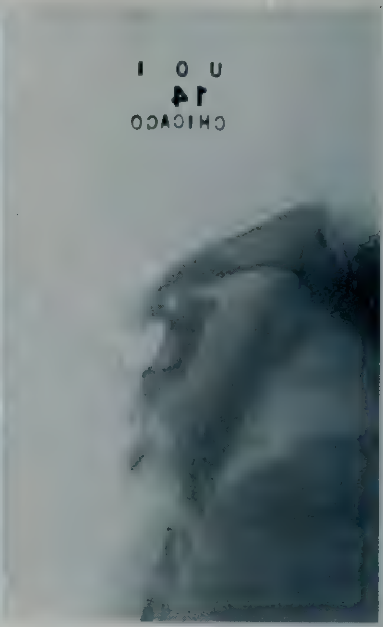


Fig. 10

Fig. 8. Dog 14. Roentgenogram 7 days after operation. Shows boiled beef bone completely disengaged from one fragment and the bone ends separated. Peg evidently too short.

Fig. 9. Dog 14. Roentgenogram 106 days after operation. Showing fragments overlapping with cross union.

Fig. 10. Dog 14. Roentgenogram 354 days after operation. Firm union.

health. March 8, 1921, there may still be felt a slight crepitus: dog well. March 22, large amount of callus, dog well, union nearly firm. May 13, there is apparently a false joint at the site of the fracture. Dog well. June 10, definite false joint. Dog well. October 18, firm union, dog well. February 8, 1922, dog has good use of leg but limps slightly. February 22, 1922, killed. Macroscopically there is marked absorption of the remnants of the pegs (Fig. 6).

Dog 14. Operation, January 28, 1921. Small black and tan dog. Shaved 3 days previously and leg wrapped in a wet bichloride dressing at that time. The dog was an old one and the marrow cavity was very small. There was a good deal of difficulty in fitting a peg into this marrow cavity. February 4, 1921, X-ray examination showed the peg to be completely disengaged from one fragment and the bone ends to be rather widely separated. March 8, dog well. March 22, dog in labor and therefore cast removed. Fibrous union only. Wound clean. Five puppies born. April 8, dog well. June 10, dog uses leg and is well. February 8, 1922, dog uses leg well. February 24, 1922, killed.

Dog 15. Operation, February 4, 1921. Medium sized black and tan. Preparation 3 days before the operation, but the dog had torn off the protective dressing. Typical operation. March 22, severe infection underneath the cast. April 8, 1921, cast removed. Infected wound near the head of the shoulder from which several bone sequestra are being extruded. Union doubtful. May 13, 1921, wound practically healed. Dog well. June 10, dog well, but doesn't use leg. January 12, 1922, killed in dog fight. Pus cavity between the ends of the bone. No union. Persistence of sequestrum formation.

Dog 19. Operation, March 18, 1921. Typical operation. March 21, X-ray shows that the bone fragments have become disengaged. April 8, 1921, dog well. December 13, 1921, killed in dog fight.

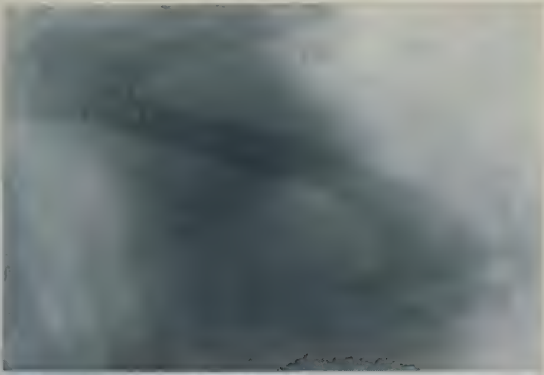
Dog 22. Operation, April 15, 1921. Typical operation. Dog prepared at the time of the operation. June 24, cast removed. Dog well. February 8, 1922, dog limps. February 10, killed. The specimen showed a false joint with fibrous union. The peg was not definitely recognized macroscopically.

Dog 26. Operation, May 27, 1921. Typical operation. Dog still walked with a limp when killed on February 10, 1922. The specimen showed a false joint with fibrous union. There was no remnant of the peg visible macroscopically.

Dog 28. Operation, October 14, 1921. Preparation: shave and iodine at the time of the operation. November 1, dog well. Skin slightly abraided under the cast. February 8, 1922, dog uses leg well. February 17, dog killed.

MICROSCOPIC EXAMINATION

From 9 animals (Dogs 12, 14, 15, 19, 22, 26, 28, 29, and 31) specimens which included the



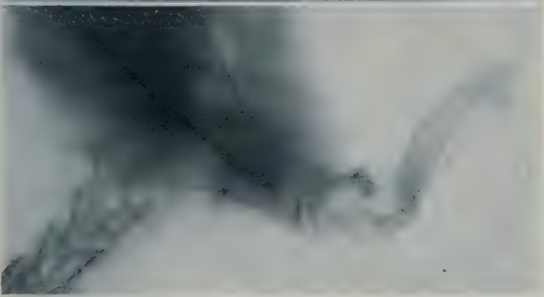
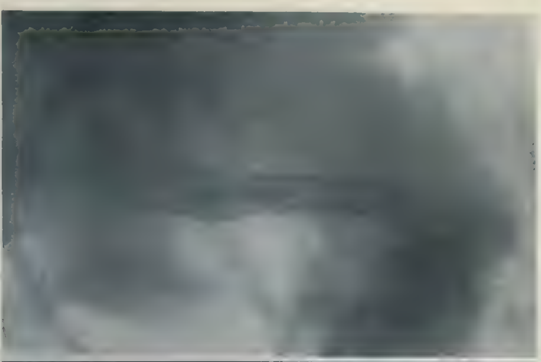


Fig. 11 (above). Dog 15. Roentgenogram 3 days after operation. Boiled beef-bone intramedullary peg in place.

Fig. 12. Dog 15. Roentgenogram 254 days after operation. Pus cavity at ends of the bone. The peg has probably been broken.



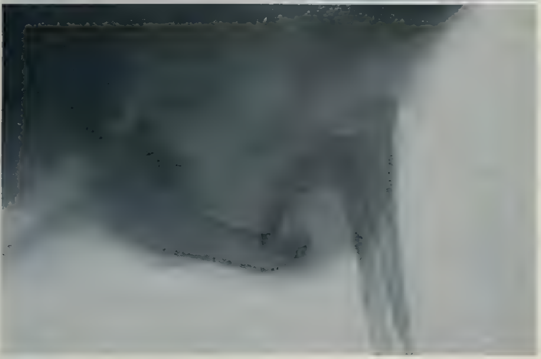


Fig. 13 (above). Dog 17. Roentgenogram 2 days after operation. Typical example of boiled beef-bone intramedullary peg. Dog died of infection 8 days after operation.

Fig. 14. Dog 22. Roentgenogram 278 days after operation. A false joint with fibrous union. Peg not recognized; has been broken after partial absorption.

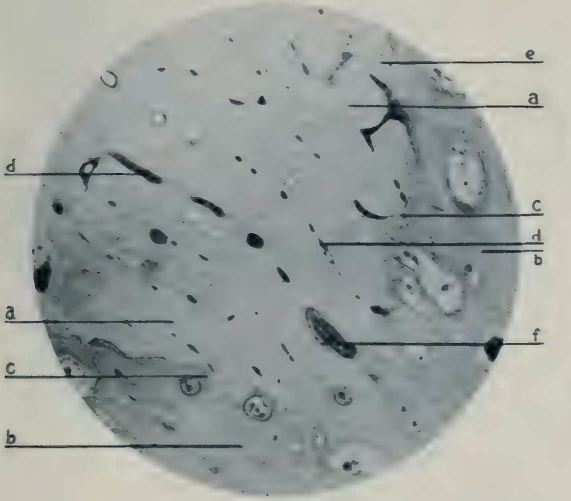


Fig. 19. *a*, Beef-bone peg; *b*, live bone; *c*, line of junction between the live and dead bone; *d*, new blood vessels which have apparently invaded the Haversian canals of the dead bone; *e*, live bone corpuscles in the borders of the dead bone; *f*, new bone formation around vessel in dead bone. (×60.)

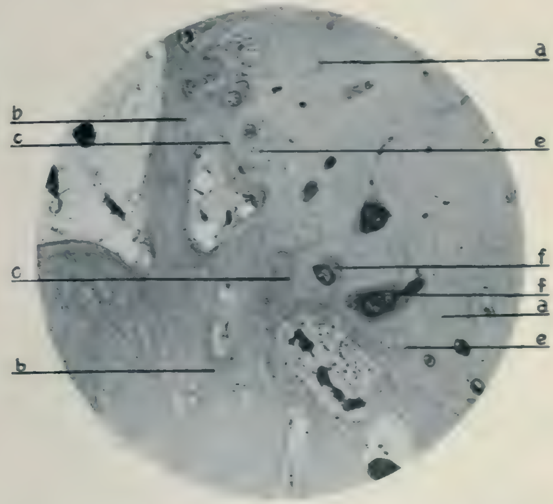
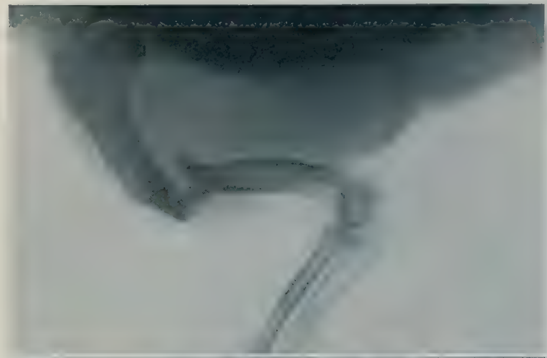


Fig. 20. *a*, Beef-bone peg; *b*, live bone; *c*, line of junction between the live and dead bone; *d*, new blood vessels in the dead bone; *e*, live bone corpuscles in the borders of the dead bone; *f*, new bone formation in the borders of the dead bone. (×60.)



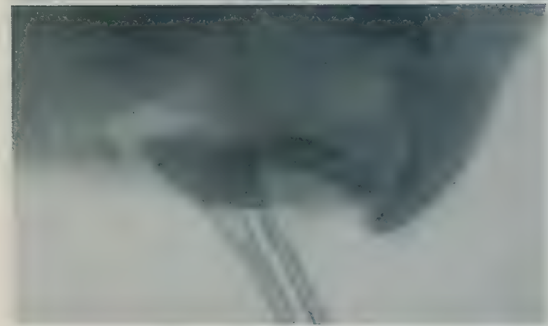
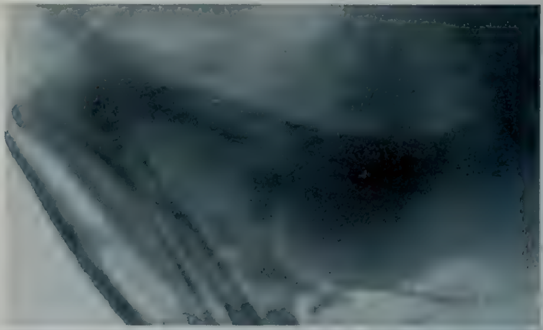


Fig. 15 (above). Dog 25. 211 days after operation. Union. Peg has been broken after partial absorption.

Fig. 16. Dog 26. Roentgenogram 204 days after operation. A false joint with fibrous union.



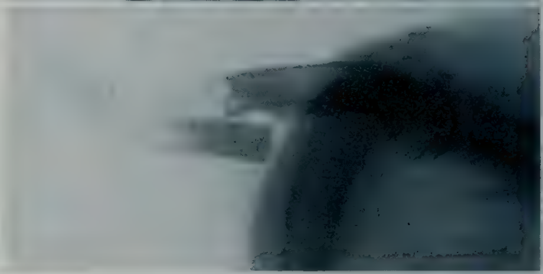


Fig. 17 (above). Dog 28. Roentgenogram 5 days after operation. This peg subsequently was broken.

Fig. 18. Dog 28. Roentgenogram 97 days after operation. Shows boiled beef-bone intramedullary peg broken after partial absorption.

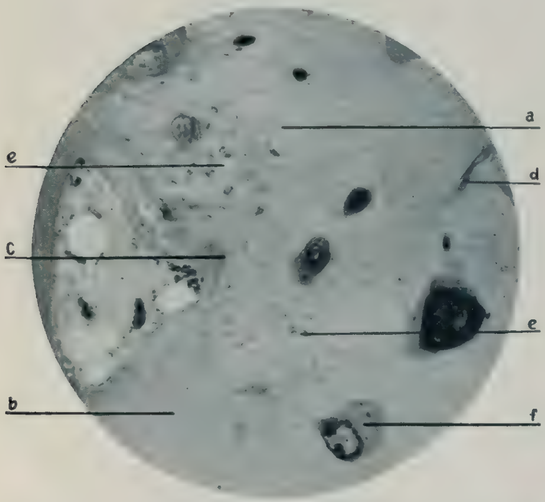


Fig. 21. *a*, Beef-bone peg; *b*, live bone; *c*, line of junction between the live and dead bone; *d*, new blood vessels in the dead bone; *e*, live bone corpuscles in the border of the dead bone; *f*, new bone formation in the dead bone. (×130.)

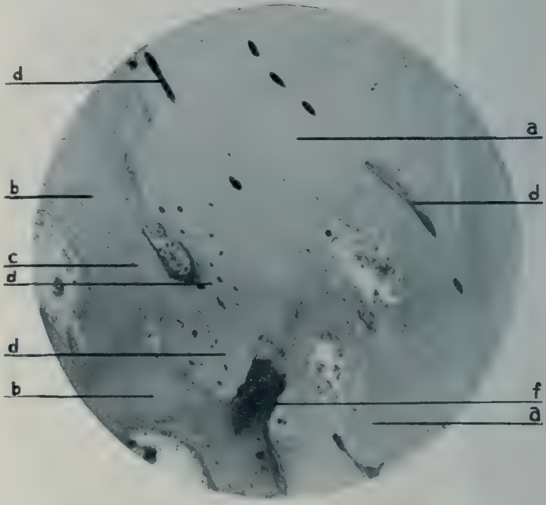


Fig. 22. *a*, Boiled beef-bone peg; *b*, live bone; *c*, line of junction between the live and dead bone; *d*, new blood vessels in the dead bone; *e*, live bone corpuscles in the borders of the dead bone; *f*, new bone formation invading the dead bone. (×130.)

SUMMARY OF EXPERIMENTS

Number of dog	Date of operation	Date of death	Duration of post-operative life in days	Cause of death	Functional result	X-Rays: Days after operation	Gross specimen	Terminal condition of peg
1	10-16-20	10-23-20	7	Infection	Negative		Severe infection (not saved)	Engaged.
2	10-25-20	10-25-20		Ether				
3	11-8-20	11-10-20	2	Shock (?)				
4	11-12-20	11-16-20	4	Infection (?) Dog was burned		3	Infection (not saved)	
5	11-19-20	12-2-20	13	Infection	Negative	4	Superficial wound healed cleanly, but site of fracture bathed in pus. No union	Engaged.
6	11-26-20	1-3-21	38	Killed by ether. Superficial infection	Poor	3	Superficial infection caused by cast so severe that dog was killed by ether. There was no bony union. Peg embedded in distal fragment, and freely movable in proximal. Fibrous false joint	Engaged.
7	12-3-20	12-3-20		Shock				
8	12-10-20	2-7-21	58	Pneumonia	Negative: Cast still on at death	5	Firm fibrous union at angle of 45 degrees. Peg disengaged from upper fragment and resting against it. Callus formation, fibrous capsule. Slight amount of motion	Disengaged.
9	12-20-20	12-20-20		Ether				
10	12-24-20	1-19-21	26	Infection	Negative: Cast still on at death	6	Skin broken down and suppurating. No union at site of fracture. Bone peg loosely engaged in the two bone ends, the marrow cavities of which show some erosion	Engaged.
11	12-30-20	3-23-21	83	Infection of chest wall	Foot drop: No union	4	Dog died of infection of the chest wall. Wound clean. Peg firmly united to one fragment but disengaged from the other. Firm fibrous union. Muscular and fibrous attachment to the bone peg	Disengaged.
12	1-7-21	2-24-22	413	Killed by ether	Dog very active: Humerus angulated to 45 degrees	3, 127, 284, 377	Large amount of callus. Pegs disengaged. Firm union at 45 degrees	Disengaged.
13	1-14-21	1-19-21	5	Infection		3	Wound infected. No union	Disengaged (?).
14	1-28-21	2-24-22	392	Killed by ether	Excellent	7, 106, 263, 354	Peg had been disengaged, but there has occurred a firm union with some angulation	Disengaged.
15	2-4-21	1-12-22	338	Killed in dog fight	Poor	3, 254	Pus cavity at ends of bone. No union. Sequestra	Disengaged or broken.
16	2-11-21	3-6-21	23	Unknown	Negative: Cast still on at death	7	Wound clean. Transplant broken with extensive overriding of fragments. Firm, fibrous union	Broken.
17	2-25-21	3-5-21	8	Infection		5	Wound badly infected, and fracture lying in a lake of pus. The bone peg still held the two ends of the fractured bone in alignment	Engaged.
18	3-4-21	3-4-21		Ether				
19	3-18-21	12-13-21	270	Killed in dog fight	Unable to use leg 3 mos. after operation	4, 214	Fragments have become disengaged	Disengaged.
20	3-25-21	4-7-21	13	Infection			Wound badly infected. Peg broken in half at site of fracture. No union between pegs and medullary cavity	Broken.
21	4-1-21	4-8-21	7	Infection			Wound wide open and infected. Fragments wide apart	Disengaged.
22	4-15-21	2-10-22	301	Killed by ether	Walks with a limp	186, 278	Peg not definitely recognized macroscopically. A false joint with fibrous union	Disengaged (?).
23	5-13-21	5-13-21		Shock				

Number of dog	Date of operation	Date of death	Duration of post-operative life in days	Cause of death	Functional result	X-Rays: Days after operation	Gross specimen	Terminal condition of peg
24	5-13-21	5-27-21	14	Unknown (no infection)		1	Peg was disengaged. No infection	Disengaged.
25	5-20-21	2-17-22	273	Killed by ether	Limps	15, 211	Irregular union at about 60 degrees	Disengaged (?).
26	5-27-21	2-10-22	259	Killed by ether	Limps	144, 204	No remnant of peg visible macroscopically. A false joint with fibrous union	Disengaged (?).
27	6-10-21	6-14-21	4	Unknown Infection not evident			No infection	
28	10-14-21	2-17-22	126	Killed by ether	Uses leg well	5, 97	Peg broken	Broken.
29	10-21-21	10-30-21	9	Unknown			No infection. Peg broken off	Broken.
30	11-18-21	1-23-22	66	Infection		62	Infection. Disengaged	Disengaged.
31	12-9-21	2-17-22	70	Unknown		41	Considerable callus formation. Identification of peg difficult in the X-ray	Disengaged (?).

junction of the beef-bone peg with the live bone were carefully removed. These sections were decalcified, sectioned, and stained. A special study was made of the material from Dog 12, which was killed 413 days after the operation. The material was typical of that found in the other sections.

Dr. D. J. Davis, head of the Pathological Department of the University of Illinois Medical School, was good enough to confirm the following observations:

1. The live bone was everywhere in *very* intimate and firm contact with the dead bone (peg).

2. The dead bone was invaded and replaced by the live bone. This process was evidenced by the following:

   a. Owing to the disintegration of the dead bone, its border was made up of a series of irregular bays or depressions into which tongues of the live bone protruded.

   b. In the receding shores of the dead bone were noted new blood vessels branching out from the live bone. These vessels were noted to contain blood. Such vessels were not observed in the central areas of the dead bone.

   c. The borders of the dead bone contained numerous bone corpuscles which were manifestly alive, while the central areas of the dead bone contained no such corpuscles.

   d. Around many of the live bone corpuscles found in the borders of the dead bone were circular areas of new live bone. This indicated that new bone was not only formed by invasion and replacement of the old, but by the deposition of new bone around the new blood vessels found in the borders of the dead bone.

   e. It seems most probable, from the appearances of the sections, that the new blood vessels have invaded the haversian canals of the dead bone.

3. The microscopic sections confirmed the observations made of the gross specimens, viz., that the pegs gradually melt away and are replaced by new bone.

4. There was no evidence that the presence of the dead bone stimulated the growth of pathological tissue of any kind.

SUMMARY

The study of these experiments has brought out the following conclusions:

1. That the part of the boiled beef-bone peg which remains in aseptic stable contact with the endosteum of its host, surrounded by living bone, becomes solidly embedded in new bone. The peg undergoes gradual absorption

and is replaced by new living bone which, later, in turn, is absorbed.

2. That part of the beef bone which lies between the fragments, but not protected by endosteum and not covered by living bone, even with aseptic surroundings, undergoes rapid absorption and disintegration and is not replaced by new living bone.

3. When one end of the beef-bone peg is not fixed in stable contact with the endosteum, but remains in position, there is absorption of both the peg and the surrounding live bone.

4. The internal callus, when the mechanical fixation holds and is aseptic, is limited by the beef-bone peg and does not bridge the line of fracture. The external callus is markedly lessened. The permanent or definitive callus is inhibited.

5. This series of experiments did not produce a single successful anatomical and functional result.

6. The causes of failure were:
    a. Infection. Infections were very frequent and usually fatal.
    b. Disengagement of the peg, due to:
        1. Failure in the mechanical reduction,
        2. Lack of continued immobilization,
        3. Loosening of the repair by absorption of the peg and surrounding live bone.
    c. Disintegration of the peg from absorption at the line of fracture. A repair, apparently mechanically perfect, would show a good result as long as the peg remained strong enough to sustain the bone. When disintegration of the peg occurred at the line of fracture, a point of mobility would be found.

The end-results were either permanent non-union or lateral union usually in malposition.

ADHESIONS ABOUT THE ASCENDING COLON SIMULATING CHRONIC APPENDICITIS

By CHARLES DAVISON, A.M., M.D., F.A.C.S., MARSHALL DAVISON, B.S., M.D.,
and DON J. ROYER, M.D., Chicago

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ADHESIONS ABOUT THE ASCENDING COLON SIMULATING CHRONIC APPENDICITIS[1]

By CHARLES DAVISON, A.M., M.D., F.A.C.S., MARSHALL DAVISON, B.S., M.D., and DON J. ROYER, M.D., Chicago

WITHIN the past 2 years our attention has been drawn to a group of cases which seem to present a new and definite surgical entity. They are of particular interest because of the ease with which the condition may pass unrecognized with a consequential non-relief of the subjective symptoms of the patient, and a reflection on the ability of the surgeon.

The interest in this group of cases was initiated by our observation of a number of patients who presented a recurrence or non-relief of symptoms following operation for acute or chronic appendicitis. Closer observation of cases giving symptoms of chronic appendicitis, in combination with roentgenographic examination, has led us to the conclusion that the condition is not a rarity, but is of a comparatively frequent occurrence.

The symptoms are those of a vague abdominal condition, and are alike in those that have been operated upon for appendicitis with no relief, and in those who present themselves with no history of previous surgical treatment. In some instances the patients have been treated medically for a chronic gastro-intestinal disorder, such as peptic ulcer, colitis, chronic constipation, or gall-tract disease. The relief under such management has been either temporary or absent, with a more or less rapid return of symptoms after a period of improvement.

The disassociation of such a syndrome with any definite condition led us to resort to complete gastro-intestinal examinations by means of the barium meal and X-ray in an effort to make a definite diagnosis, and it was by this means that the condition was first brought out. Such examinations revealed a definite and more or less pathognomonic disfiguration of the shadow contour of the ascending and transverse colon, which seemed to be caused by bands of adhesions passing over the ascending colon, involving to various degrees the transverse colon, and producing a partial or complete obstruction of the large bowel at the point of greatest involvement. In most instances the roentgenogram revealed a ptosis of the transverse colon, an agglutination of it to the ascending bowel, with a consequent kinking or constriction at the hepatic flexure. These roentgenographic findings are definite, and laparotomy reveals the mechanical condition exactly as it is shown by the plates and fluoroscope. So absolute are these findings that we are able to diagnose definitely before abdominal section the exact position and extent of the pathology. With operative interference and a mechanical correction of the pathology present, the subjective symptoms are quickly relieved, and to date we have had no recurrence reported.

A brief résumé of a few typical cases, with reference to the roentgenograms, will aid materially in the interpretation of a more detailed discussion. In each instance, only a short outline of the case is given.

Case 1. B. W., male, Jewish, age 36, clothier, married. For the past 3 weeks the patient has complained of a dull, aching pain extending from the right kidney region downward into the lower right quadrant of the abdomen. It has not been sharp or cramping at any time, but has been severe enough to cause nausea. He has been troubled with digestive disturbances of an indefinite nature for several years. He is chronically constipated, and at times is bothered a great deal by gas. The patient states that his appendix was removed 17 years ago.

Physical findings. A generalized abdominal distention of moderate degree is present. There is marked tenderness and rigidity over the entire right half of the abdomen. No definite palpable mass is present, but there is a feeling of different resistance to this portion. Leucocyte count 16,000. Urinalysis negative.

Roentgenographic findings. (Fig. 1.) Examination by barium meal. The stomach and small bowel showed no pathology. At the twenty-four hour observation, there was evidence of constrictions at the junction of the cæcum and ascending colon, and the transverse colon was adherent to the ascending portion. This remained the same at the forty-eight hour observation despite catharsis and numerous enemata, which were given with the intention of freeing the bowel of the opaque media, so that the right kidney might be visualized.

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[1] Read before the Chicago Surgical Society, April 6, 1923.

Operative findings. A high right rectus incision was made. The cæcum and ascending colon were markedly distended with gas and fluid, and somewhat discolored. The old appendectomy scar was covered with omentum. At the upper portion of the ascending colon there crossed a thick, fibrous band of adhesions, fastening themselves to the transverse colon just beyond the hepatic flexure, and producing a sharp angulation at that point. There was not a marked degree of ptosis of the transverse colon, and with the exception of the point of attachment of the band, there was no agglutination of the two portions of the colon. The band of adhesions was dissected off, a small portion of the denuded gut peritonized, and the abdomen closed.

CASE 2. N. P., male, Italian, age 56, laborer, married. The patient has been bothered with constipation for years, which has been steadily growing worse the past 6 months, until now the bowels will hardly move even with the use of cathartics. At times he notices a tumor mass in the right lower quadrant of the abdomen. This mass is about the size of a man's fist, slightly tender, seems to move about the abdomen, and disappears after defæcation. There is a severe cramping pain in the abdomen during the attacks of constipation, which is relieved by defæcation and the expulsion of gas. There is left, however, a dull, constant pain, which remains until the next attack. He is nauseated at times, but has never vomited. Appendix removed 4 years ago.

Physical findings. There is no noticeable difference in the contour of the abdomen. A moderate degree of tenderness and rigidity is present over the ascending colon and hepatic flexure, with slight tenderness and rigidity over the entire abdomen. There are no tumor masses palpable. Leucocyte count 6,200. Urinalysis is negative.

Roentgenographic findings. Examination by barium meal. The stomach and small bowel showed no evidence of pathology. At the twenty-four hour observation the ascending and transverse colons were found to be adherent, and there were apparent constrictions at the hepatic flexure and the middle third of the transverse colon (Fig. 2).

Operative findings. A right rectus incision was made at the upper quadrant. The cæcum was drawn up and inspected, and found to be dilated but freely movable. The transverse colon was ptosed, rotated anteriorly and bound to the ascending colon about 6 centimeters below the hepatic flexure by a band of the same width arising from the lateral peritoneal wall. The adhesions were freed, and the gut peritonized.

CASE 3. S. F., male, Italian, age 55, retired, married. For the past 6 months the patient has had pain in the entire right abdomen and stomach. The pain extends from the ribs downward, is acute in type, with nausea and vomiting, and seems to be slightly relieved by bowel movements. The patient has had stomach trouble for years, which he thinks has been due to constipation. His appendix was removed 5 years ago.

Physical findings. There is tenderness over the entire right side of the abdomen, most marked at the upper quadrant. Slight rigidity is present, but no palpable masses. Leucocyte count 10,000. The urinalysis is negative.

Roentgenographic findings. Examination by barium meal. The stomach showed delayed emptying time. There is evidence of a pathological gall bladder, with periduodenal adhesions. At the twenty-four hour observation, the cæcum was found to be bound down in the lower right quardrant, and the ascending and transverse colons were adherent. This condition remained constant over a period of seventy-two hours, after which the examination was discontinued (Fig. 3).

Operative findings. An incision was made over the right rectus muscle in the upper quadrant. Adhesions were found binding the transverse colon to the liver and surrounding the gall bladder. The pyloris was also bound to the under surface of the liver. The ascending colon and cæcum were bound down by bands of adhesions arising from the lateral parietal wall. The gall bladder was markedly thickened, and slightly enlarged. The adhesions about the gall bladder, pylorus, and liver were broken up; the cæcum and ascending colon were freed and peritonized, and the gall bladder was drained.

The patient died on the third day from a paralytic ileus.

CASE 4. P. B., female, American, age 30, stenographer, single. The symptoms began a short time after an appendectomy 2 years ago. The patient complains of pain in the back radiating to the right lower quadrant of the abdomen. This has been noticeable for the past year, but has become worse in the last 4 months. At times the pain radiates to the right hip and leg. It is of a dull, constant, aching character, with no acute attacks. Headaches are frequent. Nausea, but no vomiting, is present for 2 or 3 days before menstruation. Appetite is poor. The patient is always constipated.

Physical findings. There is tenderness at point of old right rectus scar extending upward to the gall bladder region. There is no tenderness in the back. Leucocytosis 9,600. Urine is negative.

Roentgenographic findings. Examination by means of a barium clysma. The colon was infiltrated and appeared normal to about the middle third of the transverse portion, where there was an apparent constriction. There was difficulty in getting the barium through the hepatic flexure and into the cæcum. The cæcum was bound down below the crest level, and the ascending and transverse colons were adherent to each other (Fig. 4).

Operative findings. An incision was made at the region of the old scar. The omentum was adherent to the anterior parietal peritoneum at this point. There was an adhesive band about 4 inches in width extending from the parietal peritoneum over the cæcum and ascending colon up to the proximal third of the transverse colon. There was ptosis and anterior rotation of the transverse colon, with angulation at the hepatic flexure. The cæcum and ascending bowel were markedly dilated. The adhesions were broken up, the colon freed, and peritonized.

CASE 5. J. G., male, American, age 60, banker, married. The symptoms have been present for an indefinite time. A dull pain is present in the right side, which steadily has been growing more noticeable for the past year. The pain never was severe until 3 months ago, when it became more intermittent and of a cramp-like nature. The patient has had indefinite digestive disturbances with frequent eructations of gas after eating. He never has a bowel movement without the use of a mild laxative. A short time ago he was given the diagnosis of chronic appendicitis by his physician.

Physical findings. The contour of the abdomen is normal. There is slight tenderness and rigidity over the region of the appendix, which extends to the upper quadrant of the abdomen. Leucocyte count 14,000. The urinalysis is negative.

Roentgenographic findings. Examination by means of a barium meal. The stomach and small bowel showed no evidence of pathology. At the twenty-four hour period there was evidence of a pathological retrocæcal appendix, and there was definite evidence of a circular adhesion constricting the large bowel at the junction of the cæcum and ascending colon (Fig. 5).

Operative findings. A right rectus incision was made. A partially obliterated appendix was found lying retrocæcally bound against the cæcum by a mass of adhesions. The appendix was dissected out and amputated. The adhesions also bound the ascending colon to the proximal portion of the transverse colon, producing a constriction of the lower portion of the ascending bowel. There was no obstruction at the hepatic flexure. The gall bladder and duodenum were negative.

CASE 6. B. E., female, Jewish, age 20, stenographer, single. Indefinite gastric distress and vomiting have been present for the past 6 months. There have been no acute attacks, but the patient has been bothered by a dull pain and discomfort over the entire right side of the abdomen. Vomiting occurs at infrequent intervals, and seemingly has no relation to the pain. The patient is habitually constipated. Dull headaches are present every few days. There has been a slight loss in weight.

Physical findings. There is marked rigidity and tenderness over the entire right side of the abdomen, especially marked over the region of the appendix. White count 11,000. Urinalysis negative.

Roentgenographic findings. Examination by means of a barium meal. The stomach showed no evidence of pathology. There was a reflex condition in the duodenum causing a gastric stasis. At the twenty-four hour observation there was evidence of a pathological retrocæcal appendix with paracæcal adhesions. The ascending and transverse colons were adherent, and there was evidence of spastic colitis (Fig. 6).

Operative findings. A high right rectus incision was made. A long injected appendix, not involved in any adhesions, was removed. The gall bladder, tubes, and ovaries were normal. A small band of adhesions arising from the lateral parietal wall extended over the ascending colon, producing a slight constriction, and binding down the region of the transverse colon just distal to the hepatic flexure, producing a moderate degree of kinking at that angle. The band of adhesions was cut and the bowel liberated and peritonized.

CASE 7. A. G., female, American, age 47, housewife, widow. The symptoms have been present for 3 years. The patient complains of pain in the right side of the abdomen radiating to the back. This pain is described as being of a pulling, dragging nature, and worse after doing heavy work. It is not influenced by the taking of food. When the pain is severe it is accompanied by nausea, but the patient does not vomit. She has been habitually constipated for years.

Physical findings. There is marked tenderness and rigidity over the entire right side of the abdomen, with exquisite pain in the right lower quadrant. There is slight abdominal distention, and a gurgling sound may be heard on auscultation. There are no palpable masses. Leucocyte count 7,200. Urinalysis is negative.

Roentgenographic findings. A barium meal was given. There was evidence of an old duodenal ulcer. At the twenty-four hour observation the appendix was not noted. There were adhesions between the ascending and transverse colons, along the entire length of the former (Fig. 7). This condition was still present at the forty-eight hour observation.

Operative findings. On abdominal section the transverse colon was found bound to the entire extent of the ascending colon by a broad band of fibrous adhesions covering over both portions of bowel. This was freed and the two portions of bowel liberated and separated. The gall bladder was atrophied to the size of a hazel nut, and contained no stones. A Riedel's lobe of the liver was present. A long fibroid appendix, lying retrocæcally with no adhesions, was removed.

CASE 8. G. W., male, American, age 44, foreman, married. The symptoms have been present for 10 years. He compains of pain at irregular intervals which is of a dull, constant nature, located in the epigastrium, right hypochondrium and right lower quadrant. The patient has had three attacks of an acute abdominal crisis which passed off in a few hours. Constipation is always present and the pain is worse when this is the most marked. He also is troubled with eructations of gas after eating. He is sometimes nauseated, but has never vomited except during an acute attack. His appetite is poor.

Physical findings. There is marked tenderness and rigidity over the right side of the abdomen from the hypochondriac to iliac regions. Tenderness in epigastrium is present, but not marked. There is a moderate amount of abdominal distention, and the abdomen is tympanitic with the exception of the right lower quadrant, where resonance is impaired. White count 6,400. The urine showed no findings.

Roentgenographic findings. A barium meal was given. There is definite evidence of a duodenal ulcer. (This perforated the evening of the first day of the examination.) At the twenty-four hour period the cæcum was found to be down below the crest level. The ascending colon and transverse colon were firmly adherent (Fig. 8). This condition was still present at the forty-eight hour period. The patient returned for operation 5 days later, and fluoroscopy at that time showed practically the same condition to be present.

Operative findings. (Case operated by Dr. Karl Meyer.) On opening the abdomen a perforated gastric ulcer was found. There was a plastic exudate between the stomach, liver and intestines, with free fluid present. The perforation was closed and peritonized. A dense band of adhesions about 6 centimeters in width covered the ascending colon, and attached itself to the transverse colon just beyond the hepatic flexure, bringing the two portions of bowel into apposition. This band was cut and dissected from the bowel wall, but peritonization of the denuded portions was impossible. A long retrocæcal appendix was found bound in adhesions which were distinct from those composing the band found at the hepatic flexure. Appendectomy was performed, and the abdomen closed without drainage.

Case 9. J. K., male, Lithuanian, age 42, machinist, married. Duration of symptoms given as one year. The patient complains of gaseous eructations, constipation, and abdominal pain. The pain is located in the right hypochondrium and epigastrium, and is worse after eating. It is dull and aching in character, never acute, and sometimes radiates to the back. The patient is at times nauseated, but never vomits. He has been treated medically for duodenal ulcer, with no relief.

Physical findings. The abdomen is scaphoid in contour. There is slight tenderness over both upper and lower quadrants of right side of abdomen, but no rigidity is present. Otherwise the findings are negative. Leucocyte count 10,000. The urinalysis is negative.

Roentgenographic findings. Examination of the stomach by means of a barium meal revealed no pathology. The duodenum showed evidence of an ulcer. At the twenty-four hour observation, the appendix appeared retrocæcal and pathological. There were definite adhesions between the ascending and transverse colons (Fig. 9).

Operative findings. A high right rectus incision was made. The ascending colon was found bound to the transverse colon at the region of the hepatic flexure by a band 4 centimeters wide, arising from the lateral peritoneal wall. The ascending colon was dilated and filled with fæcal matter. A chronic retrocæcal appendix also was found, but with no adhesions about it. The adhesive band was cut, the bowel peritonized, and the appendix removed.

Case 10. M. R., male, Jewish, age 35, salesman, married. The following symptoms have been present for 2 years. Pain in the right side radiating from the lower quadrant upward to the costal arch. A feeling of discomfort in the abdomen is always present, with periods of indigestion at long intervals. The patient vomits occasionally. He has had three acute attacks within the past 2 years which were diagnosed as being either appendicitis or cholecystitis. The patient is habitually constipated.

Physical findings. There is tenderness in the right side of the abdomen from the lower to upper quadrants, with some accompanying rigidity. There are no palpable masses. No distention is present. Tenderness over the gall-bladder area is no more marked than in other regions of the right half of the abdomen. Leucocyte count 15,400. The urinalysis is negative.

Roentgenograms of this case were not made.

Operative findings. There were bands across the colon from the lateral parietal peritoneum to the proximal third of the transverse colon. This was drawn down against the ascending bowel, and a marked angle was thus made at the hepatic flexure. The gall bladder and region of the duodenum were negative for pathology. A chronic obliterated appendix was found and removed. It was free from any adhesions whatever. The adhesive band was cut, and the two portions of the bowel separated. Only slight peritonization was necessary.

To us the etiology of this condition still is somewhat vague and not definitely determined. That it is not a congenital condition is proven by the facts that it is not evident at birth, that it is more frequent later in life, and that it seems to be a progressive affair. An analysis of the age of the patients affected leads only to the conclusion that its occurrence is at the time when all chronic abdominal conditions are most frequent, i.e., from middle adult life upward. Sex would seem to have no influence, as in this series the occurrence is about evenly divided. It is of interest to note, however, that all of the patients have led sedentary lives, and all give a history of chronic constipation. This probably is the most important single factor in the entire etiological chain.

With such an assumption we naturally turn to the theory of infection. Chronic constipation is but another term for intestinal stasis, and such stasis necessarily must be at its greatest degree in the large bowel. As a reac-

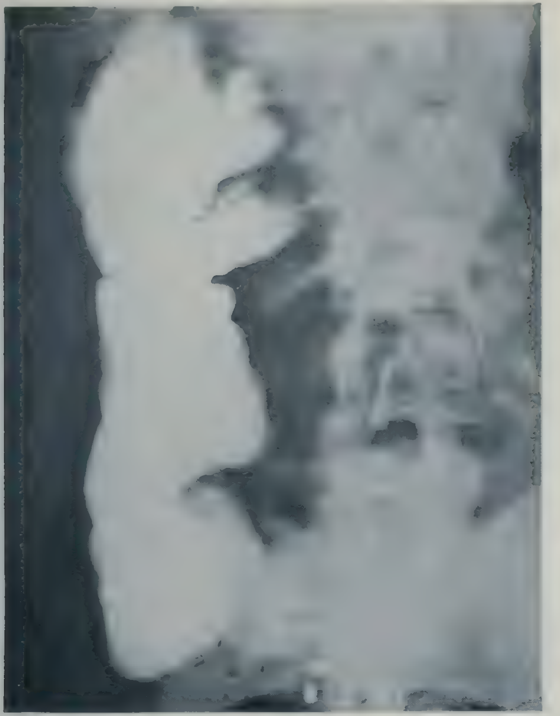

Fig. 1. Case 1. Roentgenogram 48 hours after barium meal, showing practically complete obstruction at hepatic flexure. The ascending and transverse colons are bound together by adhesive band at the hepatic flexure. Gas is seen in the ptosed transverse colon.

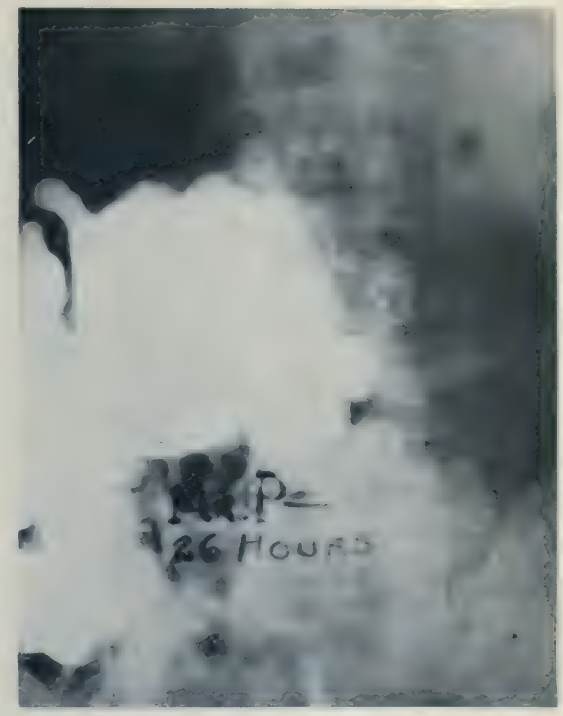

Fig. 2. Case 2. Roentgenogram 26 hours after barium meal. Shows agglutination between ascending and transverse colons by circular band at hepatic flexure extending over to middle third of transverse colon, and producing marked ptosis.

tion to the constant accumulation of fæces and resulting atonicity of the bowel, there naturally results a lowered resistance of the gut wall, and an opportunity for the migration of bacteria through to the peritoneal surface and a consequent inflammation. That the infection must be low grade is obvious, otherwise it would result in a more diffuse and acute form of peritonitis. The adhesions which would result from such an inflammatory change seem to occur locally at the point of greatest stasis, i.e., at the ascending colon. We know that for this reason the dependent location of the appendix makes it a constant cess pool of infection, and that when its ability to empty is lost, then occurs an acute or chronic appendicitis depending upon the virility of the organisms.

There is no doubt but that a chronic appendicitis is often found accompanying the condition. However the appendix is not always implicated in the adhesive bands, and very often is free, while a higher portion of the gut will show the distinct pathology. In this regard, four of the series of cases have had an appendectomy performed at intervals from 2 to 17 years before coming under observation for a new condition. This may mean one of two things: either the condition was present at the time of operation and escaped notice, or had its inception and progression at a later date. In the first instance, removal of the appendix evidently had no effect on the growth of the adhesions, or we would have had a cessation of symptoms instead of a condition growing progressively more marked. The second instance again would seem to prove that the presence of the appendix would not necessarily be a determining factor in the production of such regional adhesions. A chronic appendicitis likely has the same etiology as has the production of these bands, but it is an accompanying condition, and not a cause.

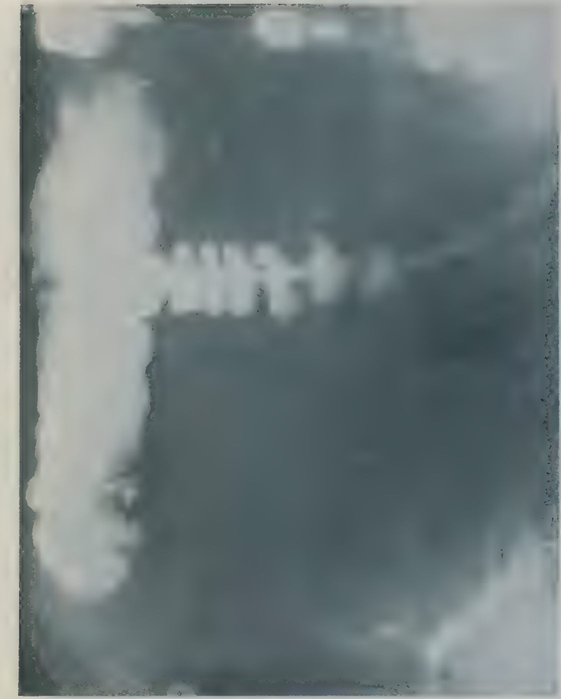

Fig. 3. Case 3. Observation at 48 hours showing complete fixation of proximal portion of transverse colon to area of ascending colon at hepatic flexure by band extending across upper portion of ascending colon. Notice the marked spasticity of the free portion of the transverse colon, which is found in practically all cases.

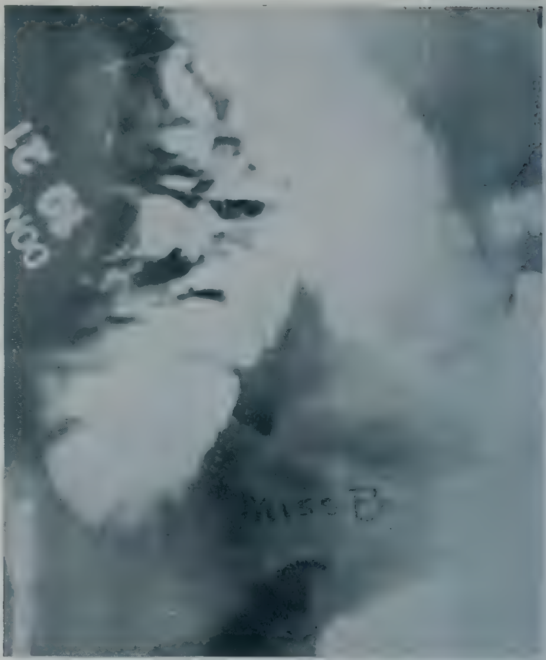

Fig. 4. Case 4. Roentgenogram after barium enema under compression, showing marked ptosis of transverse colon with traction angulation at the hepatic flexure, and agglutination of transverse to upper portion of ascending colon. The obstruction is incomplete. Outline of gas shows distention of ascending colon.

The fact that these bands seem to have a tendency to involve the colon at the region of the hepatic flexure naturally would lead us to look for such inflammatory pathology in that region as a chronic gall-tract disease, or a duodenal or pyloric ulcer. In only one case (Case 3) was any pathology found in the upper right quadrant which might have been an exciting cause, and in this instance the adhesions about the gall bladder were distinct, separated, and of an entirely different type from those that came upward from the ascending colon.

Ptosis of the transverse colon would be a very important determining factor. It will be noticed that in practically every case this condition has been found to be present, but it is no doubt more marked after the transverse colon has been dragged farther downward by the influence and retraction of the bands. If it existed early only to a slight degree, however, it would mean a definite angulation at the hepatic flexure, with a consequent slowing of the fæcal current over that portion and a resultant stasis in the ascending colon of a more marked degree.

So, it seems to us that the determining factor in the production of this condition is the stasis in the ascending colon, with the resultant possibility of band formation at the point of lowest resistance of the bowel wall.

Pathologically, the condition seems to occur in two forms. In the first, and most frequent (Fig. 10) the band seems to arise from the junction of ascending colon and lateral parietal peritoneum, spreads in a rather fan-shaped manner over the ascending colon, upward and onto the transverse colon, attaching to it at a short distance from the hepatic flexure. Evidently by contraction of the band the transverse colon is rotated anteriorly and further ptosed, bringing it into a variable degree of apposition with the ascending bowel, and thus producing a marked angulation at the hepatic flexure, and a partial obstruction.

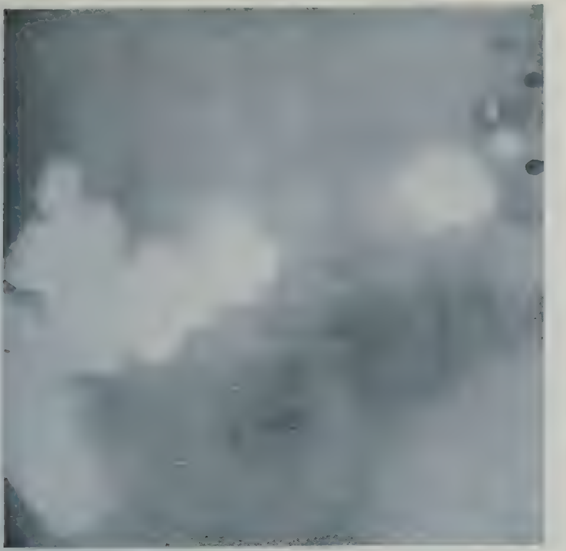

Fig. 5. Case 5. Observation after 30 hours, showing partial obstruction at hepatic flexure, slight ptosis of transverse colon, and its approximation to the ascending colon by traction.

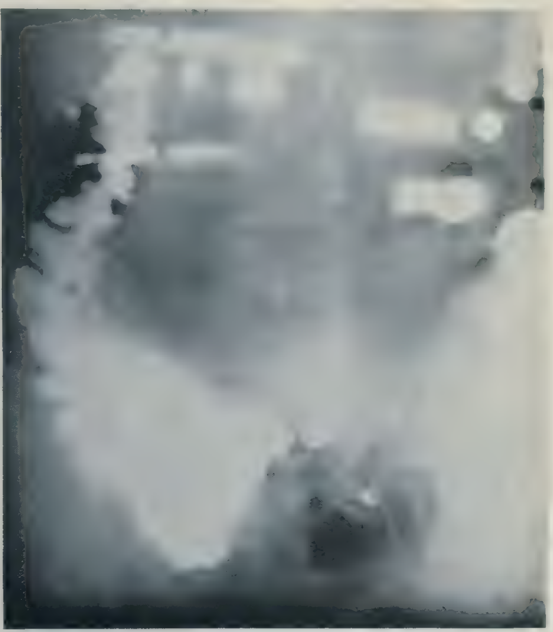

Fig. 6. Case 6. Showing partial obstruction of barium at 24 hours. Transverse colon is acutely angulated to lie anteriorly to ascending portion by traction of band in region of hepatic flexure. Gas is seen in ascending colon.

The second type (Fig. 11) may be but an earlier degree of the condition just described. In this type, the band does not reach across to the transverse colon, but rather seems only to involve the ascending portion. Evidently there occurs a thickening or contraction of the band which diminishes to a variable degree the lumen of the colon, with again a chronic obstruction. In either case they seem to arise at points varying from the mid-portion of the cæcum to a position about two-thirds the height of the ascending colon. In no case were they limited to an involvement of the cæcum, but appear to have a tendency to originate slightly higher, and to spread upward, figuratively, as if reaching for a portion of the transverse colon. In width we have seen them vary from 2 centimeters to a size sufficient to cover practically the entire upper two-thirds of the ascending colon and the proximal half of a ptosed transverse bowel, making the two portions of the colon appear at first glance as if one.

But these differences are matters of location, extent, and mechanical effects. In gross histological appearance the bands are identically the same. They are of the dull, glistening, white color of fibrous tissue, varying in thickness, but always too dense to be called a membrane. They are highly vascularized with many small vessels which seem to arise and spread out from the point of origin of the bands. In some instances the bowel wall may

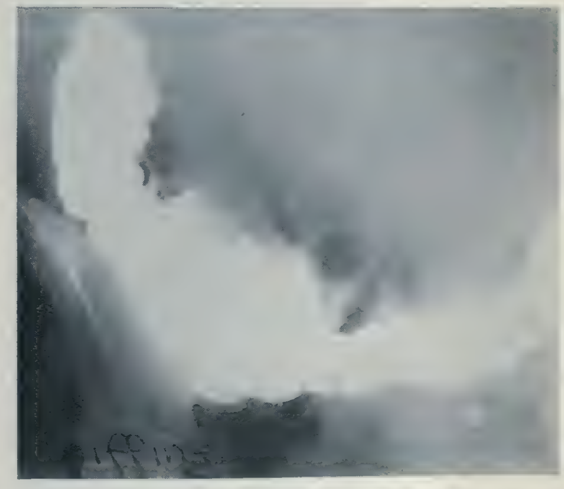

Fig. 7. Case 7. Taken 24 hours after barium meal, showing transverse colon markedly ptosed and bound to entire length of ascending colon. Under the fluoroscope, it was not possible to separate the two portions of the bowel.

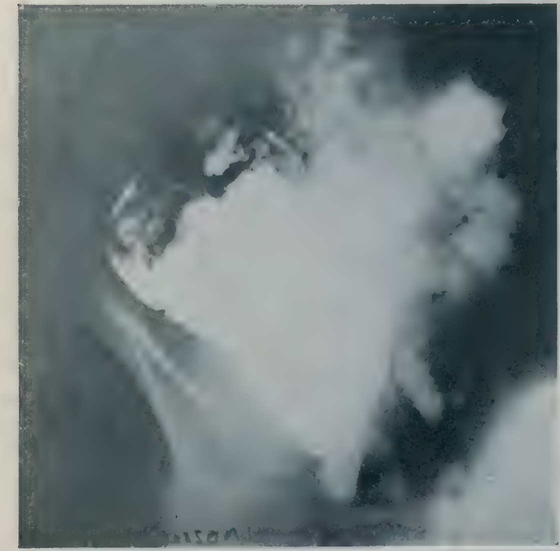

Fig. 8. Case 8. Thirty hour barium observation showing transverse colon bound to ascending colon by adhesive band, producing obstruction at hepatic flexure. This roentgenogram was practically unchanged five days later.

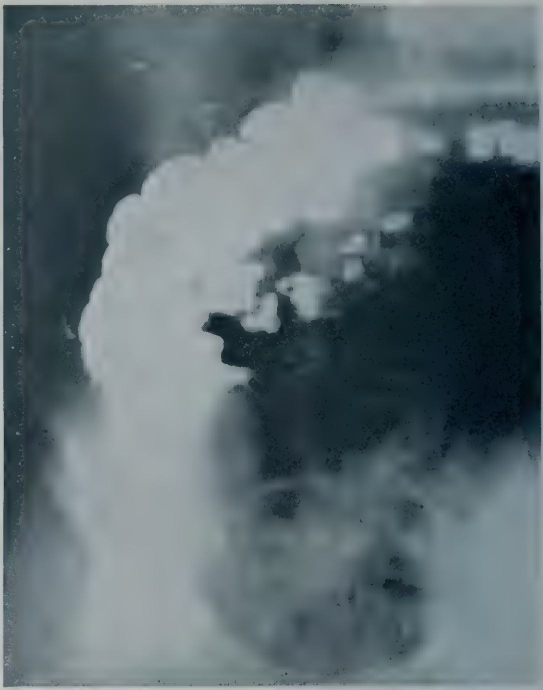

Fig. 9. Case 9. Observation at 24 hours showing fixation of transverse colon to upper half of ascending colon by band passing over the ascending colon. Notice the acute angulation at the hepatic flexure.

be visualized through this overlying structure, but in others the density is too great. The surface has almost the smooth glisten of normal peritoneum, but close inspection will reveal a definite limitation of the new tissue and its difference from the true peritoneal appearance.

Although on dissection there is a definite plane of demarcation between the peritoneal coat of the bowel and the under surface of the band, the agglutination between the two surfaces is so close that it is impossible to separate the two without deperitonizing the gut wall. Removal of the adhesive bands leaves a raw, bleeding surface, and has the same effect on the under surface of the removed tissue. Because of the close agglutination between the two, a sliding motion of the bowel in its peristaltic movements beneath the band is not possible, and any manipulation of the intestine means a movement of the entire mass to the limits of attachment of the adhesion. This condition is definitely not analogous to the membrane described by Jackson. It is not a *membrane*, but a definite *band;* it is not limited to the cæcum, and in fact does not seem to involve it to any great degree. Furthermore, it is closely attached to the peritoneal coat of the bowel from which it is impossible to be separated. Jackson's membrane is a veil-like growth, thin, transparent and vascular, which spreads over the cæcum. It is not attached to the covering of the bowel; movements between the two are possible, and careful removal of the veil does not injure the peritoneum of the gut wall.

As has been said earlier, a pathological appendix is often found with the condition. But that the two go together as accompanying pathological entities, both results of the same cause and one not of the other, seems to be proven by the fact that when a chronically inflamed appendix is found, even in the presence of adhesions, the two conditions seem always to be definitely separated and to have different grades of pathology. Again, there is that group of cases in which there are no adhesions about either appendix or cæcum, and, finally, the group associated with a normal appearing cæcum and appendiceal scar.

The symptoms of this condition simulate

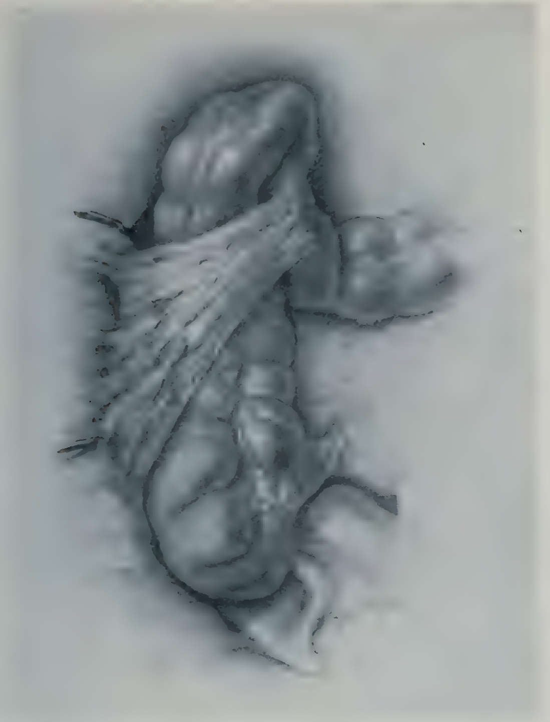

Fig. 10. Anatomical diagram illustrating one phase of the pathology. The band has its origin at junction of colon and lateral parietal peritoneum, passes over the ascending colon and is attached to the transverse portion. There results a traction ptosis and anterior rotation of the transverse colon, and fixation of it to the approximated ascending bowel.

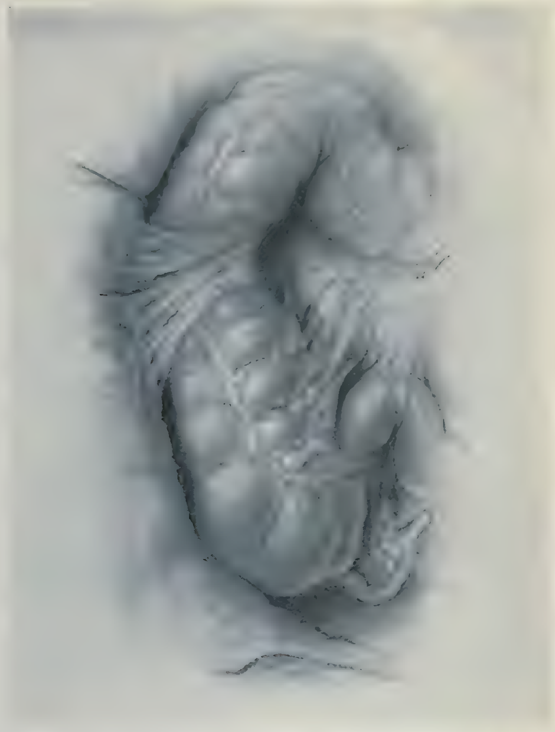

Fig. 11. Diagram illustrating different type of same pathology. In this the band does not reach to affect the transverse colon, but has its entire constricting influence on the ascending portion. Notice slight degree of ptosis of the transverse colon.

the ordinary syndromes of chronic abdominal conditions, especially that of chronic appendicitis. The chief complaint has been of a vague abdominal pain, in most cases located in the right side of the abdomen, but not definitely limited to the region of the right lower quadrant, as it generally is in a definite chronic appendix. The area of pain has a tendency to spread upward to involve the region of the right hypochondrium, and often radiates to the back. There is also an indefinite history of digestive disturbances, such as a feeling of heaviness after eating, anorexia, gaseous eructations, nausea and occasional vomiting. Constipation is the rule, and is generally so chronic that it is put in a minor quantity by the patient. Acute abdominal crises arise in this condition in instances in which there occurs a complete or almost complete mechanical intestinal obstruction, and in those instances the symptoms are classical.

The physcial findings are slightly more definite than are the symptoms. The abdominal tenderness and rigidity are somewhat more diffuse than we find them in cases of chronic appendicitis, and extend higher toward the costal arch, without involving, however, the painful area generally found in gall-bladder disease. There is no one exquisite point of tenderness, but it is diffuse over the entire region of the ascending colon to the hepatic flexure.

The leucocyte average in our series of cases was 10,000, with a minimum count of 6,200 and a maximum of 15,400. The variation may be explained on the basis of differing individual reactions to infection, amount of intestinal obstruction and consequent toxic absorption, and the condition of the appendix when present.

It may be seen from the above discussion that such a train of symptoms simulating a chronic appendicitis would be of value only in those cases in which the appendix previously had been removed, and in such instances they prove to be definite of the condition described. In any instance they may simulate any one of several chronic abdominal conditions, and in order to arrive at a definite differential diagnosis, we resort to the use of roentgenographic examinations. By this means we are able not only to rule out the presence or absence of other conditions along the gastro-intestinal tract, but we are able to remove any doubt as to the suspected condition. Too much dependence on symptoms and physical findings often will lead to an incorrect or incomplete diagnosis. We do not believe dogmatically in diagnoses which have for their basis laboratory findings with too little regard for symptoms and physical examinations. But here we have a condition which can be absolutely and definitely diagnosed by the roentgenographic findings and a complete diagnosis is possible in no other way.

In the roentgenographic examination of these patients we prefer the barium meal. The clysma rarely fails to locate the pathology, but has for its disadvantage the fact that we may fail to discover pathology higher up in the gastro-intestinal tract. The cases are examined by both plate and fluoroscope, at frequent intervals immediately after ingestion of the meal and then at successive intervals of 6, 8, and 12 hours. The observations taken at 24, 36, 48, and if necessary, 72 hours, are the most important in locating the colonic pathology, for by that time we are able to visualize relative changes in the contour of the large bowel, and the final progress of the barium into the rectal pouch. By such examinations we are absolutely able to locate the position of the band, the degree of ptosis of the transverse colon, its relative position to the ascending colon (Figs. 10 and 11), and the degree and location of the bowel obstruction. With such findings our diagnosis is complete.

The treatment, of course, is the surgical relief of a mechanical condition. An incision is made that will best expose the entire pathology, and depends upon its extent. By careful dissection the adhesive bands are freed. It is rarely necessary to resect any portion of the tissue, because there is an immediate contraction as soon as it is liberated. Due to the fact that there is such a close agglutination between the adhesive bands and the peritoneal covering of the gut, it is impossible to separate the two without injuring the peritoneal coat. All such raw surfaces must be peritonized, otherwise a reformation of adhesions will occur, practically the same mechanical condition will be present, and the patient will experience little, if any, relief.

The postoperative treatment of these cases also is of prime importance in preventing the reformation of adhesions. For several days following operation, they are kept on their left side as constantly as is possible. This has the mechanical effect of allowing the newly freed transverse colon to drop away from its former position beside the ascending portion. After time enough has elapsed for the bowel to become again peritonized, this is not necessary. As a further effort to prevent new adhesions, active movement of the bowel is kept up by the frequent administration of cathartics, preferably magnesium sulphate. This has the disadvantage of increasing gas accumulation within the bowel, but the slight bowel distention which results from the gas is an added mechanical advantage against any new adhesions. However, the patients must be watched closely, for too great a distention is a forerunner of a paralytic ileus.

SUMMARY

1. The condition seems to be a definite surgical entity.

2. Its symptoms simulate those of chronic appendicitis, but often occur after appendectomy.

3. Chronic appendicitis is sometimes an accompanying condition, but is not the causative factor.

4. Evidently it is an inflammatory lesion due to colonic stasis.

5. An absolute diagnosis may be made by means of roentgenographic examinations, and in no other manner.

6. The treatment is the surgical relief of a definite mechanical condition.

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FELLOWSHIP IN THE AMERICAN COLLEGE OF SURGEONS

By ALBERT J. OCHSNER, M.D., F.A.C.S., Chicago

IT is important that we have a clear idea of what it means to be a Fellow of the American College of Surgeons. It means primarily that the surgeon who has attained this honorable position has been judged and found qualified in all important respects by those who know him most intimately.

The judgment is passed by a credentials committee selected by ballot by the Fellows of the College for each individual state and by a central committee acting for the two continents of North and South America, who weigh carefully all of the facts brought before them through inquiries directed to fellows whose work brings them in contact with the applicant.

QUALIFICATIONS

Honesty. The first and most important qualification is honesty. If the American College of Surgeons cannot conscientiously vouch for the honesty of a surgeon it has no right to include him in its Fellowship because it would not be just to the public. A dishonest surgeon, no matter how skillful, is a menace to the community.

Ability. The second qualification is ability. A man without ability should not be vouched for to the public which has no means of determining whether the surgeon possesses the ability to diagnose the disease or the necessary skill to perform the serious work which he may have to undertake. An honest man with less ability is far safer than a dishonest man with greater ability. But the College must demand both honesty and ability.

Education. There was a time when educational facilities were so meager in this country that many most excellent surgeons were produced through almost superhuman effort although greatly handicapped through lack of educational opportunities, but in every case these men made use of all the available opportunities. Consequently, the College of Surgeons has a right to demand that the present generation make use of the improved conditions which are now available. It is proper that, at least for all of the younger applicants, a very high degree of educational qualification be demanded.

Experience. The older surgeons can remember when only few opportunities for gaining experience were available before entering individual practice. The hospital positions for young men were few; there were no fellowships and very few assistantships, consequently the young surgeon was compelled to accumulate his experience in his personal practice.

At the present time many such positions are available and consequently it is right that the young surgeon shall accumulate a large experience in the service as an assistant of an older experienced surgeon before taking the responsibility of independent surgical work of a serious character in which his inexperience might endanger the life or health of the patient. It is, therefore, right that the College should require experience as one of the qualifications for Fellowship.

Human interest. No surgeon can become a useful member of society unless he shows human interest in those who entrust themselves to his care.

A selfish surgeon lacking human interest is a menace to a community and does not deserve the prestige given him by Fellowship in the College.

Industry. Unless a surgeon is industrious he will soon become inefficient, because he does not keep up with the advances of the surgical profession. Such a member of the profession has no right to enjoy the benefits of Fellowship. His example is especially harmful for the development of the younger generation of surgeons.

Ethics. In order to build up the surgical profession of a community, it is important that the ethical relations toward other surgeons and to the public be correct.

There is a close relationship between the first and last requirements. A surgeon who is absolutely honest can not well be unethical and vice versa; but there are certain relations, in which custom plays an important part, which introduces a difference.

Ethical conduct implies honesty, fair play, and consideration for the other person's interests. It represents the practical application of the Golden Rule both to colleague and client which is often not an easy matter especially in a profession in which the element of competition is so important a part as in the practice of surgery.

There was a time when many of the most honorable members of the surgical profession felt that in order to deal fairly with the practitioner who referred patients to them, a portion of the fee should be paid to the practitioner. The result of this, however, proved most pernicious, because it developed a form of barter in human life. In

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many instances the practitioner referred the patient not to the most competent surgeon but to the one who was willing to pay the highest percentage of the fee collected, without regard for his learning, experience, skill, and judgment. This really meant nothing more nor less than barter in human life.

The American College of Surgeons demands of applicants for Fellowship that they be not guilty of this practice and will not be in the future. It makes the practice of splitting of fees in any form an absolute reason for preventing the admission to the American College of Surgeons on the one hand, and a cause for expulsion from the College on the other.

In the large as well as in small communities it is true to human nature that professional jealousies should exist, but the college has a right to expect its Fellows to put aside all personal differences and to support for Fellowship every colleague who possesses the required qualifications without regard to personal likes or dislikes. It would be quite as reprehensible to recommend for Fellowship a friend lacking the proper qualifications as it would be to oppose a candidate possessing these qualifications because of a personal dislike.

It is the duty of every Fellow to encourage young surgeons in the acquisition of the necessary qualifications, because it is exceedingly important to this country to give proper development to the next generation of surgeons.

Selfishness has no place in the acceptance or rejection of candidates for Fellowship.

HISTORIES

The College demands from each applicant that he submit a sufficient number of histories of important cases treated to convince the examining committee; that the applicant make it his practice to give each patient that comes under his treatment a careful physical examination; that he give proper consideration to the clinical history; that he make the necessary laboratory examinations; that he invite consultation when necessary; that he plan the necessary treatment or operations carefully and avoid unnecessary operations; that he show proper surgical judgment and skill in performing the operation; that he record postoperative conditions and end-results.

It seems that there can be no method more favorable than this to determine a basis upon which the College can base its judgment for vouching to the public that the surgeon has proper scientific and technical qualifications.

It must be remembered that carelessness on the part of the College in admitting surgeons to Fellowship might cause great harm to the public, because the public has learned to trust their lives in the hands of the Fellows of the College. That a surgeon is not a Fellow of the College does not necessarily mean that he is incompetent or dishonest. There are nearly two thousand surgeons who have applied for Fellowship whose credentials have not convinced the committees that they are competent for admission to Fellowship. No doubt in many of these cases the defects in the records will be cleared up and they will later be admitted, but before they can be admitted your committees must be convinced that all of the requirements have been fulfilled. There are many young surgeons with splendid training who are looking forward to Fellowship as soon as they have acquired the necessary experience. The fact that these are not Fellows at the present time is no discredit to them so long as they are striving in an honorable way to acquire the necessary qualifications.

It is the duty of the Fellows to inspire these young men with the ideals of the College so that they may in due time strengthen the organization.

To the public the American College of Surgeons must mean that its Fellows can be trusted because of their honesty, their learning, their experience, their skill, their human interest, and their ethical appreciation of the Golden Rule.

Fellowship in the American College of Surgeons must mean that every surgeon who has this distinction deserves the absolute confidence of the community in which he lives.

THE TREATMENT OF CANCER OF THE JAW WITH THE ACTUAL CAUTERY *

A. J. OCHSNER, M.D.
CHICAGO

During a period of nearly forty years I have had an opportunity of observing and treating a very large number of cases of cancer of the jaw, first as chief assistant of Prof. Charles T. Parkes for three years, and later for four years in the same position with Prof. Nicholas Senn in the enormous surgical clinic these men conducted from 1888 to 1895 at Rush Medical College and the Presbyterian Hospital in this city. Since 1888, I have acted as surgeon-in-chief of Augustana Hospital, and since 1895, of St. Mary's Hospital, and in each of these services many of these cases have come under my observation and treatment—126 operative cases during the period of twenty years from 1901 to 1921.

In 1888, I became greatly interested in the treatment of cancer of the uterus by means of the actual cautery, introduced by Dr. John Byrne of Brooklyn, which Professor Parkes employed regularly in hopeless cases of uterine cancer. To our amazement, a number of these patients, in whom the growth was so far advanced that it seemed they could live but a short time, certainly less than two years, remained well for years without recurrence, some being well at the present time. This fact convinced me that the action of the cautery destroys cancer tissue, or cancer infection, far beyond the tissue actually removed. It seems as though possibly the severe heat applied to the malignant tissue may have produced antibodies, which in turn affected the infectious material which had already been carried beyond the reach of the direct destruction caused by the heat. At any rate, our observations con-

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* Read before the Section on Stomatology at the Seventy-Fourth Annual Session of the American Medical Association, San Francisco, June, 1923.

firmed all of the well known claims of Dr. Byrne. As a result of these observations, I came to use the actual cautery in the treatment of cancer whenever this was possible.

At that time, cancer of the upper jaw was looked on as practically hopeless, and cancer of the lower jaw, though treated by means of a very mutilating operation with extensive excision, resulted in permanent cure in only a very small percentage of cases. One of my earliest patients, whose case had been declared hopeless by some of the most experienced surgeons and by the professor of pathology in one of our best universities, who made the microscopic examination, is alive and well today after a period of nearly thirty-five years, while the professor and all of the surgical colleagues who expressed an opinion have long gone to their reward. In this case, I first applied a plan which I have practiced ever since and which has been followed with success by many surgeons who have visited my clinic.

We burn away tissue until we are certain that we have destroyed all of the diseased portion, and then we burn away as much more as we feel we should have to destroy after the first recurrence, without regard to the deformity or to the plan that we have to employ later on in our reconstruction, or to the trouble our dentist friends will have in providing a proper artificial substitute for what we have destroyed. It is quite remarkable how cleverly they improvise useful and esthetic substitutes for our ruthless destruction of tissue.

By far the most useful instrument which we have employed for carrying out this operation is a small copper soldering iron about 1 cm. square and 2 cm. long, which we heat to red heat in a gas flame such as tinsmiths employ. The heat carried by this metal when red hot is enormous, and reaches some distance beyond the tissue actually destroyed. It seems wise to hold the iron in one place for a minute or longer in order to cook thoroughly the tissues rather than simply to pass it over the surface back and forth, because although the latter process will destroy the cancer tissue on the surface quite as perfectly, the heat cannot penetrate to the same depth. Consequently, if the cautery is not held in one place long enough to cook the tissues thoroughly, there may be small projections of cancer tissue, or slight invasions of cancer infection, which may escape destruction and may serve as foci from which recurrence may have its beginning.

In order to prevent the setting free of cancer infection, we avoid the use of the knife or chisel, even when the growth is extensive or when it invades the bones to a marked extent. In these cases, we first cook the tissues, including the bône, and then cut away the tissue that has been rendered harmless by the application of this tremendous heat. After cutting away all of the apparently diseased tissue that had previously been cooked, we invariably apply the red hot soldering iron again in order to make sure that no particle of infected tissue may remain. Every slightest portion of surface is gone over. One cannot be too careful or too thorough. One must especially guard against the very common error at the primary operation of going only a slight distance beyond the growth. Whenever possible, one should burn away the entire growth and 2 cm. of tissue beyond in every direction. In my own experience, several lives have been lost from recurrence in cancer of the upper jaw because I was unwilling to sacrifice the eye in the primary operation; while patients with a similar condition are still alive and free from recurrence after many years, because I avoided this blunder. By employing the methods of reconstruction illustrated by Blair and Galli and others, one can obtain results later on much less repulsive than one would expect after these mutilating operations.

It seems worth while to mention the subject of removal of a portion of the tumor for microscopic examination. I have met a large number of patients who later lost their lives as a result of metastases caused by the removal of a small portion of a malignant growth for microscopic examination previous to the operation. We all know what frightful consequences result from cutting into a melanotic nevus.

In many cases of cancer, the excision of a small portion of the growth for microscopic examination has precisely the same effect. It removes the natural barrier that seems to protect the patient against liberating the cancer infection and permitting the formation of metastases. Unfortunately, in my experience, this form of metastatic infection due to removing a portion for microscopic examination has usually occurred in patients in whom the growth at the time of operation was not at all advanced and in whom the free removal would most certainly have resulted in a permanent cure.

There is, however, a safe method of obtaining a portion for microscopic examination in case the surgeon is too stupid or too inexperienced to recognize a malignant growth in any individual case under consideration. A portion sufficient for microscopic examination may be removed from the tumor with the electric cautery, and the raw surface thoroughly cooked with the soldering iron without fear of dissemination. Before thorough microscopic instruction was universal in medical schools, it was a practice of those who were familiar with the use of the microscope to lay great stress on the importance of microscopic examination before operation, because this gave them a kind of exclusive position, a kind of monopoly on being thoroughly scientific and quite above the common herd of surgeons.

Being intensely interested in microscopic study of tissues, which I taught and practiced daily from 1882 to 1891, I made a practice of comparing the gross and the microscopic diagnosis of malignant growths in my own practice and in the clinics of my chiefs, Professor Parkes and Professor Senn, and for two semesters of Professor Billroth while I was in daily attendance at his clinic. In only one case during the two semesters did the microscope fail to confirm the diagnosis Professor Billroth had made from the gross appearance of the specimen removed, and that was in a case of blastomycosis or granuloma, which had not been described before 1887, when my observations in Billroth's clinic were made. During the years 1888 to 1895, I, myself, prepared and studied microscopic sections from every tumor removed by Professor Parkes and Professor Senn, and here again I found that their diagnosis from the gross appearance was practically always confirmed by the microscope.

Since that time I have, personally, with my staff of assistants, studied microscopic sections of every tumor I have removed, and have frequently compared the diagnosis made by these assistants with the microscopic findings, and have found that the older assistants, who had been in our service a year or longer, almost invariably made the correct diagnosis from the gross appearance of the tissue removed, together with the history of the case. I am convinced that, in case of doubt, the growth should always be removed with the cautery, never with the knife, and the diagnosis confirmed by microscopic examination afterward.

It is quite possible that the same results can be obtained by the use of diathermy, because the tremendous heat developed by this method should theoretically be quite as effective as the heat produced by the soldering iron. Judging from the extensive reports of Clark and others, this seems to have been established in practice, but my personal experience with this method is too limited and too recent to warrant an expression of an opinion.

Our plan of conducting the anesthesia seems to be of sufficient importance to deserve mention, because we have had no cases of postoperative pneumonia since introducing this method. The operation has been very smooth and uninterrupted by mishap or disturbance due to the anesthesia.

The patient is given ¼ grain of morphin and $\frac{1}{150}$ grain of atropin from one hour to one and one-half hours before the anesthesia is begun, and one half of this amount is given half an hour before anesthesia is begun. Then the patient is anesthetized very thoroughly, but very slowly, with ether by the drop method, the patient being in the horizontal position. When the anesthesia is complete, the head of the table is elevated to 45 degrees, and the anesthesia will then be perfect for from one-half to one hour without the use of any further ether, because of the anemia of the brain caused by the elevated position of the head.

This time will suffice to complete the operation. In the meantime, the patient has exhaled a large portion of the ether previously inhaled, and when the head is lowered, the patient awakens almost at once. The total amount of ether required is greatly reduced and by elevating the head of the bed or permitting the patient to sit up in bed with a head rest, all danger from hypostatic pulmonary congestion and pneumonia is eliminated. There is, of course, considerable danger from postoperative hemorrhage in extensive cases, but as all of these cases are absolutely hopeless without operation, or with a more limited operation, it is well worth while to take the additional risk.

The use of the cautery treatment as described above does not preclude the use of radium or the roentgen ray. In fact, for several years we have systematically given these patients intensive roentgen-ray and radium treatment either before or after the operation, and in certain cases both before and after the operation.

In other cases, when it has seemed advisable, we have placed a row of radium needles entirely round the growth before removing the growth with the cautery.

The treatment with radium and the roentgen ray has been under the direction of Dr. Henry Schmidt, who has made a special study of this subject, enabling him to determine the amount and time best suited for the individual case.

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THE USE OF X-RAY AND RADIUM FROM THE STANDPOINT OF THE CLINICAL SURGEON

By ALBERT J. OCHSNER, M.D.
Chicago

It is no doubt of importance to get the viewpoint of all medical men who have had an opportunity to observe the effects of X-ray and radium during the introduction of these agents as therapeutic aids, because this form of treatment has been in its experimental stage to the present time, and the more data that can be collected the more likely will definite knowledge be available in the future. The experienced clinician has the advantage of having observed many similar conditions in patients suffering from malignant diseases both before and since the introduction of these therapeutic aids.

It is not safe to base one's judgment simply upon the daily impression in one's practice because with every new remedy the imagination of the clinician is likely to be stimulated as well as that of the patient and both may see an improvement where an uninterested observer might find no change. On the other hand, it is equally unsafe to rely upon statistics entirely, although these are far safer than general impressions, but with the best intentions it is not always possible to take into consideration all existing conditions. There is, however, one element in the consideration of the present subject which must be conceded.

Every practitioner with a wide experience in the treatment of patients suffering from malignant diseases knows that there is a group of cases in which the growth has advanced to a point where complete removal is no longer possible and where the destruction of the patient's life is a matter of a short time only.

In these cases there can, of course, be no definite measure of time, because the clinician's judgment concerning the prognosis must depend upon the number of similar cases he has had an opportunity to observe, as well as upon his powers of observation and his judgment, or upon the combined judgment of all the clinical observers interested in the study and observation of the individual case.

Since the introduction of X-ray and radium we have had an opportunity of observing many cases belonging to this group that were in a condition from which in former times we could have predicted a fatal outcome within a relatively short time, a few months at the latest, in which the patient has made apparently a complete recovery after the application of X-ray or radium treatment, or the combination of both, under the direction of a competent radiologist. In most instances this was possible by combining the use of these agents with surgical treatment.

It is for this reason that the radiologist who undertakes the treatment of malignant growths should possess wide clinical experience, and should not simply act as a technician.

Whether or not these cases will remain permanently free from recurrence must be determined after many years of observation, because the time is still too short since the beginning of thoroughly scientific methods of application of radium and X-ray treatment to make absolutely definite statements concerning permanency of recovery in these cases.

In my own practice, I have, during a period of ten years, referred all cases in which I thought radiologic treatment indicated, to my colleague, Prof. Henry Schmitz, so that all of them are included in his published reports. From these cases I will select only one group for illustration because this will serve to express my views upon the subject.

During my experience with inoperable cancer of the uterus, before the introduction of radiologic treatment, these cases rarely lived longer than two years, although occasionally an apparently inoperable case recovered permanently after intense cauterization with the soldering iron. Since the introduction of radiologic treatment with the application of radium directly to the cervix and uterine cavity, and deep X-ray treatment over the external surface, the prognosis has become very much more favorable. We have a group [1] of fifteen of these apparently hopeless cases, out of a total of seventy-eight, or nearly 20 per cent. living, free from recurrence five years and longer after application of this form of treatment.

The same is true concerning our experience with the treatment of cancer in other portions of the body, so that we have for some time followed the plan of invariably preceding the removal of malignant growths by the careful, thorough, preliminary X-ray treatment, and our observations seem to indicate the wisdom of this plan.

As yet we have not determined whether it is more advantageous to operate shortly after the X-ray treatment, or to wait for a number of days, as suggested by some colleagues, until the malignant growth shows the full effect of the treatment, but it has seemed to us that some hopeless cases in various portions of the body have remained well that would otherwise have suffered from recurrence a short time after operation according to our previous experience. We have, however, made it a rule in every case to make quite as thorough an operation as we should have made had we not made the preliminary radiologic treatment.

In cancer involving the body of the uterus and not the cervix, we still perform panhysterectomy *per vaginam* because we have been thoroughly satisfied with the results of this operation. In these cases we use the electric cautery in severing all the tissues involved.

In inoperable cancer of the cervix, or better in cases of cancer of the cervix in which the growth is not absolutely circumscribed, although strictly speaking they may not be properly classed as inoperable, because in former years some of these cases remained permanently well after operation with the actual cautery, we apply radium directly to the cervix and to the cavity of the uterus invariably and give deep X-ray treatment over the external surface after a method which has been fully described by Prof. Henry Schmitz.[2]

In no case of malignancy except in cancer of the uterus and in some cases of superficial skin cancer, do we depend upon radium or X-ray, either alone or combined, but simply as an aid to surgical treatment, and in no case have we temporized with the hope of ultimately making surgical treatment unnecessary.

It has seemed better to give the patient the full effect of radium and X-ray treatment and immediately follow this with the most thorough surgical treatment as indicated by our previous surgical experience, and to do this at the earliest possible moment.

We have been convinced that this plan of treatment should be followed because of the satisfactory results we have had, and because of the fact that we have encountered many cases in which valuable time had been lost because the physician who directed the treatment, when the growth had first been noticed, had hoped to make surgical treatment unnecessary by the application of radium or X-ray treatment. In many of these cases the history showed that the treatment promised well at first, but that later the tumor grew with increased vigor only to be referred for surgical treatment when the condition had advanced to an absolutely hopeless stage. It might be argued from this that X-ray and radium treatment should not have been employed in these cases because there was no ultimate benefit from it. This conclusion seems wrong because the clinical evidence seems to show that even these cases showed marked improvement after the proper application of radiologic treatment, but it should not have been expected of this treatment to do the impossible.

Similar cases in which added surgical treatment was employed immediately after the use of radium or X-ray, or both, were especially favorable in the ultimate result.

Our experience in the use of radium and X-ray treatment in connection with surgical treatment of malignant growths seems to warrant the following conclusions:

1. The use of radium or X-ray, or both, results in permanent cure in a large number of superficial skin cancers.

2. In inoperable cancer, originating in the cervix uteri, the combined X-ray and radium treatment is strongly indicated.

3. In cases of malignant tumors, which are operable, X-ray or radium treatment should precede or follow surgical operation. We prefer to give this before the operation.

4. In no case should operation be postponed in operable cases of malignant tumors in the hope of obtaining a permanent cure with X-ray or radium alone, except in superficial skin cancer.

5. In cases which seem absolutely hopeless with any form of treatment, or with the combination of all forms, radium or X-ray, or both, may be employed for the purpose of giving temporary relief, but the friends of the patient should be told that nothing further than temporary relief can be hoped for.

6. The treatment with radium and X-ray should invariably be directed by a physician who has a thorough scientific knowledge of the physics of radiology and experience in clinical surgery.

7. Careless or unscientific X-ray and radium treatment may do much harm.

8. In carcinoma originating in the cervix uteri we use radium and X-ray only except in very early cases, because here we can use radium with greater intensity than elsewhere, to the extent of practically destroying the organ, so that it ceases to function, which prevents lighting up the malignant process.

9. Elsewhere except in superficial skin lesions the re-establishing of the function of the part involved seems to result in recurrence, hence our practice of surgical removal after careful radiologic treatment.

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CHARLES THEODORE PARKES

By A. J. OCHSNER, M.D., F.A.C.S., Chicago

DURING the years immediately following the beginning of antiseptic surgery, a group of young surgeons appeared in America with quite unusual qualifications—men with boundless energy, unflinching perseverence, absolute honesty of purpose, clearness of judgment, exalted enthusiasm, and an intense desire to advance to the highest surgical excellence.

Many of these surgeons were splendid anatomists and excellent practitioners of general medicine, but had not enjoyed the benefits of a university education. In many cases, however, the student had engaged in teaching public school, or had broadened his mind by contact with men of ability during service in the army in our Civil War.

These men were hardy and clear-headed, unafraid of hardships or hard work. What they lacked in scientific training they made up in character and personality, and in those individual characteristics which enable men to accomplish unusual ends, and to leave a lasting impression upon their fellow workers and upon their community.

The most brilliant and withal the most lovable and attractive, and in his personality the most distinguished of all the surgeons of this group, was Dr. Charles T. Parkes of Chicago. Physically large and powerful, he was able to perform an unbelievable amount of work. Mentally a giant, he was able to grasp the surgical problems of his day with a clearness and precision which have rarely been equalled among the many great surgeons whose work I have been privileged to observe. His success depended primarily upon natural ability, personality, industry, and perseverence, but his environment and education aided greatly in bringing about such unusual results.

For generations his father's people were iron-workers in Stratfordshire, England. His mother's family had migrated to England from Brittany. His parents came to America in the late twenties of the past century. His father engaged in the production of iron, becoming half owner of one of the largest iron works in the west, located at St. Louis, Missouri.

During these years young Parkes enjoyed educational advantages in private and public schools, interrupted attendance at high school and 2 years at Ann Arbor University. The panic in the late fifties swept away his father's fortune,

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and this and the beginning of the Civil War interrupted his education. He taught school before joining the Union army at the age of twenty. He entered service as an enlisted man, and during his 3 years' service he became the most skillful drillmaster in the 117th Illinois Volunteer Infantry. While holding a captain's commission, he was given an independent command at Island No. 10 in the Mississippi River. He received mention in the War Department Records for an act of heroism.

Immediately following his discharge from the army, he entered Rush Medical College becoming the special student of the professor of anatomy. No doubt his army experience gave Parkes a willingness and an ability to do the enormous amount of work involved in carrying his studies, while doing the work of assistant to the chair of anatomy and acting as prosector.

Shortly after his graduation in 1868, he was made demonstrator of anatomy, which position he held until 1875, when he was elected to the chair of anatomy in Rush Medical College. This position he filled with distinction until the year 1887, when upon the death of Professor Moses Gunn, he was elected to occupy the chair of principles and practice of surgery and clinical surgery in his Alma Mater.

Shortly after his graduation, he received the appointment of surgeon to the North Chicago Rolling Mills, attending surgeon to Cook County Hospital, attending surgeon and later surgeon-in-chief of St. Joseph's and Augustana Hospitals, and attending surgeon to the Presbyterian Hospital. Dr. Parkes studied in London, Edinburgh, and Paris during the year 1878, and visited the surgical clinics of Germany during the summer of 1888 and 1890.

Dr. Parkes possessed great physical and moral courage. A story of his army life shows this side of his character. During an engagement, while within easy range of the enemy, it became necessary to signal to a re-enforcing division. In order to be seen, he mounted a fence in view of the enemy and gave his signal with a flag. Immediately a volley aimed by the enemy shattered the fence, fortunately leaving him unharmed on the ground. The flag, with its shattered staff, is in the State Museum at Springfield.

The following story is told to illustrate his enormous physical strength. In demonstrating anatomy, he was constantly annoyed by a large fellow, who persisted in crowding in ahead of the other students. When the patience of Dr. Parkes was exhausted, he picked the man up bodily, passed him over his head, and dropped him down behind him, to the great pleasure of the class.

Parkes received much inspiration from the remarkable men who composed the faculty of Rush Medical College from 1865 to 1890. Every man was a leader of men. They may not have ranked so high, in a cultural sense, as some professors in eastern medical schools, but they were enthusiastic teachers, who made teaching their first responsibility. Among these men were Moses Gunn,

Charles Theodore Parkes
1842–1891

J. Adams Allen, William Byford, Robert L. Rae, Henry Lyman, Edward Holmes, Delaskie Miller, Joseph Ross, J. W. Freer, and later Norman Bridge, James Nevius Hyde, and the best teacher and most charming gentleman of all, Walter Haines.

With these remarkable men he worked with wonderful enthusiasm, first as student and assistant, and later as the most distinguished colleague. His lectures and clinics were perfectly prepared, without regard to what it cost in fatigue or sacrifice, in consultation or practice. His college work was always his first responsibility. It was this which cost him his life. He was taken with influenza, but would not remain at home on his clinic day, although he was strongly urged to do this. During this clinic he had his fatal chill.

Parkes was one of the first surgeons west of Boston, New York, and Philadelphia, who performed many abdominal operations during the years 1880 to 1890. His diagnostic ability was so great that he acquired a national reputation which brought difficult cases to his clinic from many states. His absolute mastery of anatomy, with his years of practice in the dissecting room, gave him a command of surgical technique which I have rarely seen equalled and never excelled. His familiarity with every tissue enabled him to complete an extensive operation in an incredibly short time with an amount of traumatism so slight, when compared with that produced by other surgeons, that his patients came out of the anæsthetic with enormously less shock than similar patients operated on by other surgeons. They consumed much less ether, were exposed a shorter time to the possibility of infecton, and their wounds were in a much better condition for primary union because the tissues had not been unduly traumatized. He emphasized the importance of tying sutures so as to secure exact co-aptation, but never strangulation of tissues. His wounds healed regularly by primary union quite to the extent that such results are obtained in the very best clinics today.

With the exception of operations upon the eye, nose, and throat, he covered the entire field of surgery, excelling in general, abdominal, and gynecological surgery. His operations on bones and joints, and those for club feet, wry neck, cleft palate, hare-lip, and other deformities were quite remarkable and original. Here again his complete anatomical knowledge gave him an unusual advantage. He was, I believe, the first surgeon in this country to remove a stone from the pelvis of a kidney, and from the common bile duct, and one of the first to perform many gall-stone operations.

Parkes was one of the first surgeons in this country engaged in extensive original research and animal experimentation. His address "The Treatment of Gunshot Wounds of the Small Intestine as a Result of a Series of Experiments on Forty Dogs" presented before the American Medical Association in 1884, is a splendid piece of work, and his conclusions are still surgically correct. This was the most notable one of his many excellent papers. Of these, one on cholecystostomy, and one on choledochotomy, which operations he performed in 1885, amputation of arm, together with clavicle and scapula for sarcoma in 1889 with report of two cases, fifty successive cases of ovariotomy for removal of tumors, 1888, received international attention.

Parkes entered the field of surgery before Billroth, Volkmann, and Fenger had introduced pathologial training in the field of preparation for entrance into surgical practice; in fact before American medical colleges were equipped with pathological laboratories, but his surgical judgment was so excellent and his observations so acute and so extensive that this lack of training in a subject, upon which we now lay so much stress, did not seriously impair his surgical efficiency.

As a teacher, Parkes was the ideal of the medical student and the practitioner alike, because he gave them in a clear, concise way, exactly what they needed in their practice, not loaded down with a lot of irrelevant material. This is shown with great clearness in his clinical lectures which were taken down stenographically during the last year of his life, and published after his death. I have recently read these lectures again, and was amazed to see how much of the best of our present surgical practice they contained. Practically all of the younger surgeons of the middle and western states attended his enormous clinics at Rush Medical College, and followed his teaching in their practice. Thus he became the teacher of hundreds of progressive young surgeons.

Parkes died March 28, 1891, at the age of forty-eight, at the height of his success. He kept thoroughly abreast with all advancement in surgery of his day, and received recognition from all sides. Few men have had the personality, the industry, and the ability to accomplish so much as did Dr. Parkes in the few years of his too short life.

Periarterial Sympathectomy

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In 1851, Claude Bernard discovered that, when the sympathetic nerve is cut in the neck of a rabbit, the blood vessels in the ear of the same side become very much dilated. He and other observers afterward demonstrated that, if the peripheral (head) end of the severed nerve is stimulated electrically, the ear becomes blanched, owing to a constriction of the blood vessels. Bernard also discovered a second class of nerve fibers, which, when stimulated, caused a dilatation of the blood vessels in the area supplied.

The vasoconstrictor nerve fibers belong to the sympathetic autonomic system, consisting, therefore, of a preganglionic fiber arising in the central nervous system and a postganglionic fiber arising from the cell of some sympathetic ganglion. These nerves form plexuses in the media of arteries and terminate in contact with the muscle fibers. While the terminations of the nerves are in the media, the adventitia, or externa, is spoken of as the nervous layer; for it is into and through this layer that the fibers must pass before entering the media. The adventitia consists of connective tissue, which is denser and contains more elastic fibers in its inner portion. A prominent layer of elastic tissue near the media is called the outer elastic membrane. In the larger vessels, the adventitia contains small nutrient blood vessels, the vasa vasorum, which may penetrate the outer part of the media.

The recent work of Leriche [1] of Lyons has been of great interest and value to those endeavoring to treat vasomotor and trophic disturbances. Leriche has observed that, when the sheath of an artery is removed, one can see, just at the moment its external layer is pinched, that the vessel contracts, its pulse stops, and its size diminishes. If the cellular layer is excised, the diminution in size will progress to one third or one fourth of the normal size of the artery. After from three to fifteen hours, secondary signs invariably appear. These are: (1) elevation of local temperature from 2 to 3 degrees, giving the patient a subjective sensation of heat; (2) elevation of arterial pressure, which may be as great as 4 cm. of mercury, and (3) increasing amplitude of oscillations. Leriche says the vasodilator reaction is transitional after periarterial

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[1] Leriche, René: Tr. Am. Surg. A. **39**: 471, 1921.

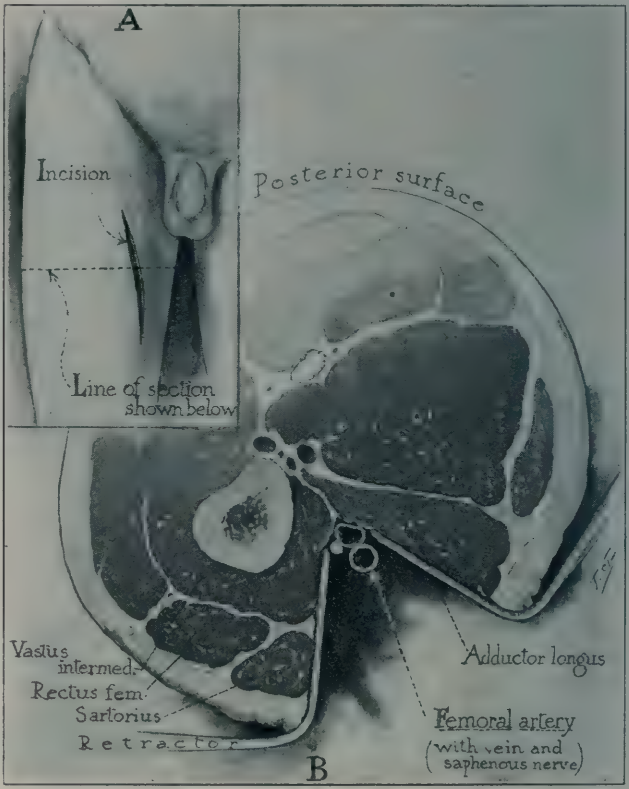

Fig. 1.—*A*, method of approaching the femoral artery; *B*, cross-section of thigh, showing relationship of femoral artery.

sympathectomy; becomes attenuated from the fifth and sixth day, and disappears after from three to four weeks.

Leriche's operation has been to isolate from 8 to 10 cm. of the artery. The sheath is divided and, with one part held by forceps, the tunica adventitia is dissected away with either a knife or a cannular sound, until the vessel has been completely denuded. This procedure does not injure the main artery wall. Leriche has performed the operation 64 times; in 11 cases of causalgia or equivalent syndromes, 2 cases of painful stumps, 19 cases of posttraumatic contractures, 4 cases

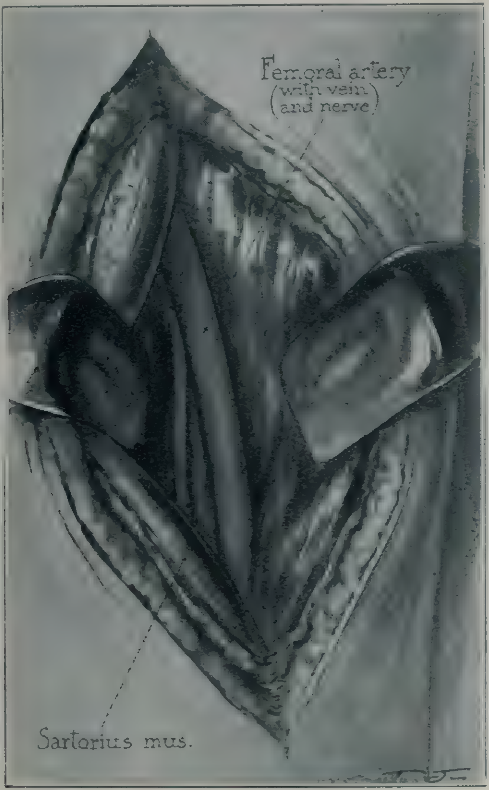

Fig. 2.—Exposure of femoral artery.

of large traumatic edemas, 1 case of trophedema, 4 cases of ischemic sequelae, 1 case of trophic sloughs on a stump, 10 cases of trophic sloughs after nervous section, 1 case of sore of the heel after medullary injury, 1 case of varicose eczema, 1 case of trophic trouble after frostbite, 1 case of spasmodic paralysis, 3 cases of an attempt to modify tension of the cerebrospinal fluid, 2 cases of jacksonian epilepsy, 1 case of goiter, 1 case of intermittent claudication and 1 case of erythromelalgia.

His study of cases leads him to believe that periarterial sympathectomy (1) is often very efficacious in painful phenomena; (2) will influence hypertonic symptoms of muscular phenomena, and (3) is very efficacious in trophic troubles which lead to ulcers.

Following is a case in which periarterial sympathectomy was performed:

REPORT OF CASE

History.—V. P., a sleeping car conductor, aged 55, was admitted to the medical service of Dr. Arthur R. Elliott, St. Luke's Hospital, Chicago, April 6, 1921. A tentative diagnosis of endarteritis obliterans was made by the admitting physician.

Six weeks previous to admission, the patient's right foot began to be painful and feel numb, and these symptoms had grown progressively worse. The pain radiated to the calf of the leg and the ankle felt weak. The patient was unable to walk more than half a block at a time; and, for the last four days and nights, the pain had been excruciating, preventing sleep. There had been no similar attack, and the foot had not swelled. The patient had typhoid fever and "soft chancre" at 17 years of age, but otherwise the history was negative. The family history was also negative.

Examination.—The right pupil was slightly larger than the left, and both reacted rather sluggishly to light and accommodation. The musculature of the extremities was fairly well developed. There was no paralysis, and no tenderness save in the right foot, which was painful when manipulated, and, to a lesser extent, in the right calf, on palpation. The body was otherwise that of a normal, healthy man.

April 9, the blood sugar was 0.091 per cent., the blood urea nitrogen 17.47 mg. per hundred cubic centimeters, and the total nonprotein nitrogen, 38.95 mg. per hundred cubic centimeters. The Wassermann reaction was clearly negative. There were 4.980,000 red blood cells and 10,050 white cells; hemoglobin, 90 per cent. The urine showed a faint trace of albumin, a few hyaline casts, no sugar, and an occasional leukocyte.

Diagnosis.—A diagnosis of endarteritis obliterans was made by Drs. Arthur R. Elliott and George W. Hall.

Treatment.—The patient was given 4 liters of Locke's solution daily by mouth and the duodenal tube, and hot formentations were applied to the foot. He made some improvement. April 26, he was given sodium citrate 120 grains (8 gm.); Locke's solution, 64 ounces (2 liters); potassium iodid, 30 grains (2 gm.); sodium bromid, 20 grains (1.3 gm.), and hydrated chloral, 5 grains (0.3 gm.). After a few days, the sodium citrate, sodium bromid and chloral were discontinued. May 1, nitroglycerin, ¹⁄₁₀₀ grain, every two hours for eight doses daily, was started, and was continued a week. May 17, thyroid extract, 5 grains (0.3 gm.) twice daily was started, and, May 19, sodium nitrite, 2 grains (1.3 gm.), every four hours. May 27, the electric oven was

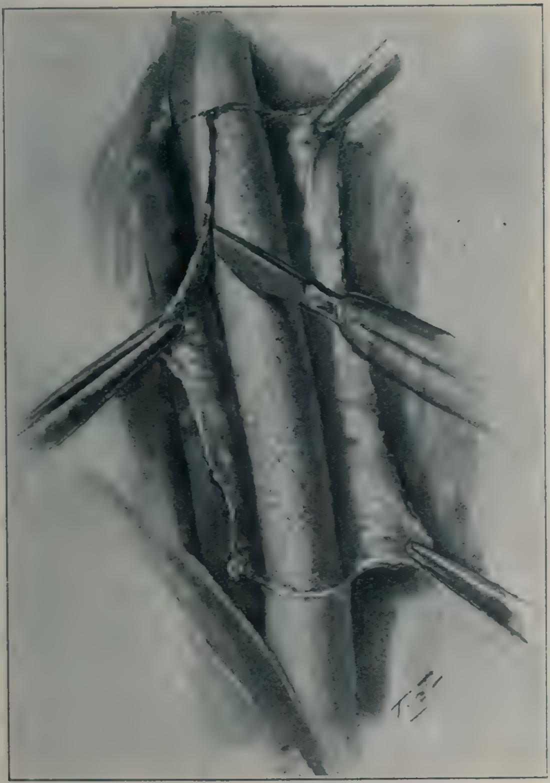

Fig. 3.—Method employed in removing the adventitia of the femoral artery.

tried on the foot, and nitroglycerin was substituted for sodium nitrite. June 4, massage of the leg was started. June 24, 300 c.c. of 0.5 per cent. sodium citrate was given, intravenously. The condition was unchanged throughout.

August 13, the patient was seen by Dr. Halstead, who advised an attempt at periarterial sympathectomy or an amputation. August 24, the patient was transferred to our surgical service.

Operation.—August 26, the femoral artery of the right leg was dissected out so that the junction of the middle and lower thirds was visible. The adventitia was incised with great care and stripped completely off for a distance of 5 cm. The wound healed rapidly and cleanly, and the patient was discharged on the thirteenth day after operation, September 8.

July 21, 1922, ten months after operation, the patient was admitted to St. Luke's Hospital for carbuncle of the neck. Operation of incision and drainage was carried out.

Outcome.—The patient is working as cashier in a restaurant and is on his feet most of the twelve hours that he is on duty. He is able to walk a mile or more. There is no pain in the leg except a slight one if he walks rapidly. Numbness, which was present at the time of operation, has practically disappeared. Before the operation, the patient was unable to do anything, and the pain was most severe when lying in bed. Now there is no pain. The general health is excellent. The leg used to be cold but gets warm in bed now. Tactile and thermal discriminations are normal. The scar is pale and the wound is cleanly healed.

30 North Michigan Avenue—Winnetka Bank Building.

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CANCER*

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There is no subject of greater general interest now than that which has been assigned to me. It is only possible to consider a few phases of so important a disease in a short paper. Volumes have been written on it in the past two decades. A great deal of research work, experimental, clinical and statistical, has been done in that time. In short, war on cancer has been declared.

A former Chicago man, the late Roswell Park, in 1899, I believe, started the first society in the United States for the study of cancer, at Buffalo, and Dr. Gaylord, who is still with that institution, and has done a great deal of research in cancer, has favored us here with his reports. Many associations at home and abroad have been formed since that time for the same purpose, notable among which are the American Society for the Control of Cancer, the American Society for Cancer Research, etc. Numerous others have been working in England, Germany and other countries. Doubtless the successful war waged on other diseases and the increasing incidence of cancer in almost every country, if not all, have stimulated the effort to combat the disease, and much has been accomplished, notwithstanding the pessimistic view prevailing.

Thirty years ago, Professor Agnew said (as quoted in the Jour. Am. Soc. for Cont. of Cancer) that he had never cured a cancer of the breast.

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*Read before Section on Public Health and Hygiene, Illinois State Medical Society, May, 1922, at Chicago.

Every surgeon now has cases cured for many years.

Thirty years ago the mortality from diphtheria in Chicago was approximately 35 per cent. Then, after the cause was discovered, antitoxin came into use, early diagnosis was made and the mortality dropped to 3 per cent, and should be zero. War was also waged on tetanus, malaria, typhoid, syphilis and tuberculosis, with the result that all these were put on the list of controllable diseases. All this and more in thirty years. During that time, with all the sanitary advance that has been made in fighting these known germ diseases, there has been a steady increase in cancer. An increase of about 1 per cent. to 2.5 per cent. a year, I believe, is the estimate.

It is said that one woman in ten after forty years of age will have cancer, and one man in eleven. There are about 80,000 deaths per year in the United States.

Notwithstanding all the study referred to, the cause is unknown, although much has been learned about the subject which may lower the death rate when the knowledge is generally applied. It is now generally agreed that cancer is at first a local disease and when accessible, especially, cure follows complete removal. There are few men of authority who deny this at present—I know of no surgeon. Dr. Bulkley, a noted skin specialist, is one in opposition to it.

The belief in the past that cancer was a constitutional disease discouraged many from asking early operation, and this contributed to the high death rate by postponing operation, rendered surgery less effective, and reacted on the operative treatment, thus establishing the vicious circle.

Experimental, clinical and statistical research has now fairly settled this question, but people generally have not yet been convinced as they should be. The prevailing disbelief in operation for cancer is an echo of the former theory of the constitutional character of the disease.

That skepticism is emphasized further by the fact that people generally hear and know more about one death from cancer than they do of five cases that are cured. The one death advertises itself, the five cures are not paraded. Early operation will cure 90 per cent. of accessible cancers and a considerable number of those more or less inaccessible. Radium and x-ray will also cure some of these. Every experienced surgeon can show numbers of cases illustrative.

Irritation of one kind or another is now known to be the exciting cause of most, if not all, cancers. Full acceptance of this fact is bound to be the most influential factor in lowering the mortality. The jagged or foul tooth starts the cancer of the tongue or cheek. The hot rice of the Chinaman or the betel nut chewed by the natives of India, and possibly the hot tea or coffee used by other people are factors in mouth cancer. The pipe, maybe the cigar, of the smoker—man or woman—often starts cancer on the lower lip.

Dr. W. J. Mayo is a strong believer in the effects of heat, in whatever form or place, in provoking the start of cancer.

The abuse of food and drink will doubtless be shown to explain the large number of stomach cancers, as well as those of the alimentary tract, including the liver.

Statistics generally show that cancer of the digestive organs is more frequent than that of any other part of the body, especially in men.

Exceptions to this are found in India, where cancer of the stomach is rare, and among aborigines and people in institutions where a frugal diet is enforced.

It seems from available figures that cancer of the stomach is a part of the cost of high living.

People who eat much meat and raw vegetables are the greatest sufferers from cancer of the intestinal tract, while those who, from religious or other reasons, cook their vegetables and eat little meat, have the lowest mortality. The North American Indians are cited as exceptions to the influence of meat eating, but here again the other more natural habits of primitive man, and a more generally restricted diet, come in to offset the meat eating.

Again, skin cancer is most prevalent in those countries where filthy habits prevail, and is least frequent where cleanliness is the rule. In India, where we have noted that stomach cancer is rare, skin cancer is very prevalent. In Japan, where the bath is universal, skin cancer is rare. The theory of chronic irritation by dirt and neglect is borne out. Where cleanliness is considered next to godliness, no skin cancer; where cleanliness is considered next to foolishness, much skin cancer! In parts of India where the natives wear the Kangri basket, with an earthen vessel in which they burn charcoal to keep warm, frequent burns on the skin result in cancer. Where they chew the betel nut they have frequent mouth cancers.

We all know some sad examples of x-ray burns resulting in cancer starting in the skin. We know, too, that old sores, scars, warts or moles, leucoplakia, intractable ulcers or eczemas, are often the starting point. Gall stones start cancer in the gall bladder, ulcer of the stomach is many times the cause in disease of that organ. Troublesome hemorrhoids precede cancer of the rectum and eczematous nipples often start cancer of the breast. Lacerations of the cervix uteri, together with catarrhal irritations, are believed responsible for many cancers there.

Irritation has been shown to be at least the exciting cause of cancer in the chimney sweep—the gardener who handles soot to sprinkle the plants, the coal tar and aniline dye worker, as well as those of other occupations bringing about chemical or other irritations. Bloodgood claims that in 1,200 cancers of the skin a previous defect in the skin was shown in the history.

Some of the factors mentioned, such as the eating of raw vegetables, the effect of dirt on the skin, filthy habits, etc., have been cited as evidence of the parasitic nature of the disease. (Ochsner.) In my opinion there is all along the line an explanation through irritation as the exciting cause, with no proof of parasitism, and no final solution of the ultimate cause. It is admitted, however, that the theory of parasitism is not disproven.

Cancer is not contagious and has not been proven to be a parasitic disease. A majority of surgeons, especially those in research work, disbelieve in the parasitic theory. I recall that twenty-five years ago Professor Senn (Principles of Surgery) argued against its infectious character, the argument today being perhaps the strongest, i. e., that the identity of the cell growth in cancer, in whatever tissue it is lodged or metastasized, e. g., a squamous cell from the skin lodged in the liver maintains squamous cell type. In known germ diseases the same does not hold.

A most convincing argument against the contagious theory, at any rate, is the immunity of surgeons, nurses or relatives of cancer patients. It has been so rarely found in man and wife that it can easily be a coincidence. Efforts at transference in man from one to another have rarely been successful, and when successful, apparently the growth has not kept up the usual life history or development. The victim of cancer, however, is an easy prey to transference of his own disease to one part or another of his body. The disease is individual to him. So much is he susceptible to transplantation that some tissue change is presumed to make him susceptible. Cancer is seemingly individual to its host, and does not easily transfer its habitat. No characteristic chemical or microscopical change of blood tissue or secretions has been demonstrated, however, in cancer patients; and so far as we know, food, environment, climate, occupation, have little to do with preparing the system for cancer, except as they do so through irritation.

If the aborigines are more immune, it may be we shall have to return to a more simple life, with normal work and frugal fare. It may become known through further study what influence is required to make a person susceptible to cancer. If senility is a cause, it is not progressive with age. Jonathan Hutchinson pointed out many years ago there is a local senility as well as general.

Of course cancer has a predilection for the person or the tissue that has reached its maturity and is ready to decline, but strangely enough it does not increase its ravages progressing with age.

From forty to sixty-five is, I believe, the time of greatest frequency; an average age is about fifty years. It is rarely hereditary, but Miss Slye and others experimenting with mouse cancer find an element of susceptibility of tissues that is considered hereditary, very much, I take it, as we consider heredity in tuberculosis. No method of immunization has been discovered for cancer in man.

What has been said as to the predisposing cause, local character of the disease in early stages, and curability through radical early operation, leads to the conclusion that there is a great responsibility on the physician who is first consulted by a patient with suspected cancer, or with a suspected precancerous condition. In addition to caring for cases of suspected cancer, it is the function of the physician to advise his patient about the risk from neglected warts, ulcers, fissures, tumors, vaginal discharges, digestive disturbances, or other precancerous conditions, and to be an apostle of clean, simple and temperate living.

If it is necessary for a patient to consult a dentist regularly for the protection of his teeth, why should he not consult a physician who can and should make a thorough general as well as special examination to see that there is no insidious approach of cancer. Where the patient presents cancer in an early stage, a prompt, thorough operation, with follow-up by x-ray or radium, is the best treatment. The late J. B. Murphy showed that in a large percentage of cancers there was no spread of the disease until late in the case, many of them proving fatal before metastasis occurred. Needless to say, Dr.

Murphy was a staunch supporter of the local character of the disease in its beginning, and he had proven that early operation would cure.

Notwithstanding the great increase in the number of cancers, there has never been a time when the outlook for the individual patient was as favorable as at present. Bloodgood believes if the patient is seen early by a thorough surgeon, cures in cancer of the breast should reach 86 per cent., of the skin 98 per cent., of the lip or tongue 90 per cent., of the bone 75 per cent.

Dr. Mayo has shown cures in approximately one-third of stomach cancer cases from operation. Broder of the Mayo clinic, 23 per cent. plus of cures in cancer of the genito-urinary tract. Martin thinks uterine cancer should show operative cures of 25 to 48 per cent. They should show better with early diagnosis. These enumerated are the more frequent sites. Stomach, intestinal, breast, skin, genito-urinary tract operations at present are supplemented by x-ray and radium with great advantage, and in inoperable cases much has been done by these agents. Through early diagnosis and prompt surgical treatment, the mortality should be less than half the present figures.

Until the ultimate cause is found our best known means of prevention are restriction and care in eating, drinking and the use of tobacco; cleanliness and proper care of the skin, mucous membrane and intestinal tract; the avoidance of all local irritations, especially those caused by heat; the proper treatment of tumors, ulcers, scars, moles, warts, keratoses, irritating discharges, digestive disorders, etc., and a more simple mode of life, with moderation in all things.

SUMMARY.

Cancer is on the increase, approximately 1 per cent. to 2.5 per cent. annually. Cancer of the stomach heads the list among Caucasians, and its increase and distribution suggests that it is a disease of civilization. The cause is not known, but it starts through chronic or recurring irritation. Cancer is not a constitutional disease starting from within, but a local disease excited from without by some form of chronic or repeated irritation, through some unknown cause. Many precancerous conditions lead up to cancer, e. g., moles, warts, fissures, ulcers, scars, burns, kerastoses, etc.

Cancer remains a local disease until death in about 20 per cent. of cases, and until late in life in many. Heredity does not play an important role, although it is probably a small factor.

Early operation cures nearly all accessible cases if done well and radically. X-ray and radium will cure many superficial cases and possibly many deeply seated. Great responsibility for early diagnosis rests with the physician, and general and special examinations should be made at intervals. Early diagnosis is not always easy—easy diagnosis means often advanced disease and formidable operation.

Further study may solve the problem of susceptibility of a subject, from which other deductions as to etiology or immunity may be made. There never was a time when a patient with cancer had so good a chance for recovery as now, through early diagnosis, removal of cancerous or precancerous conditions, radical operation, radium and x-ray.

I believe the death rate from cancer will be cut in two in the next decade, through the general application of the present knowledge on the subject.

It is certain that the frequency will be greatly reduced by early attention to tumors, moles, warts, kerastoses, irritating discharges, digestive disorders, care in diet, and cleanliness and a more simple and wholesome life.

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True Cholesteatoma of the Cecum

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CHICAGO

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AMERICAN MEDICAL ASSOCIATION
FIVE HUNDRED AND THIRTY-FIVE NORTH DEARBORN STREET
CHICAGO

TRUE CHOLESTEATOMA OF THE CECUM *

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AND
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As far as we are able to learn from the literature, we are presenting the first reported case of intestinal cholesteatoma (epidermoid). This is rather puzzling, because twelve cases of dermoid cysts, which, from a histogenetic point of view, stand close to epidermoids, are reported in the region of the colon, and about twenty more in the mesentery of the small intestine.[1] Cases of ovarian dermoid cysts are sometimes localized quite close to the intestine.

Under the name cholesteatoma, two different things are understood. First there are rare cystic tumors with thin epithelial lining and a silvery content, which is formed of epithelial cells and cholesterol tablets. Such tumors are found in the skull, the spinal cord and very rarely in the cranial bones—frontal sinuses [2]—and temporal bones. These are supposed to be true tumors originating from meninges or displaced embryonic epidermic germs. At some place in the covering meninges or neoplastic cyst wall, a squamous epithelial lining is always present.

On the other hand, sometimes chronic inflammation with squamous epithelial metaplastic transformation of normal epithelial covering, or partial destruction of a squamous epithelial duct, can produce practically the same changes, including microscopic structure. It occurs in the ear (otitic cholesteatoma), urinary passages,[3] gallbladder, mammary gland and uterus. In these cases we find no neoplastic elements—just the same epithelial covering perhaps undergoing metaplastic changes. This produces, through desquamation, the characteristic silvery content in the previously existing

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* From the West Suburban Hospital, Oak Park, Ill.

[1] Forster: Beitr. z. klin. Chir. **124:** 116-138, 1921.

[2] Wolff, H.: Beitr. z. klin. Chir. **130:** 215-223, 1923.

[3] Klug, W. J.: Beitr. z. klin. Chir. **127:** 123-131, 1922.

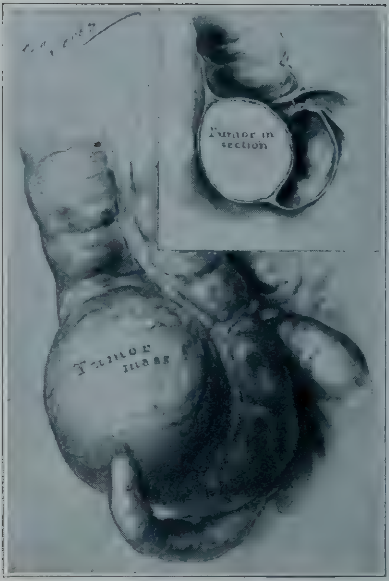

Fig. 1.—Gross specimen.

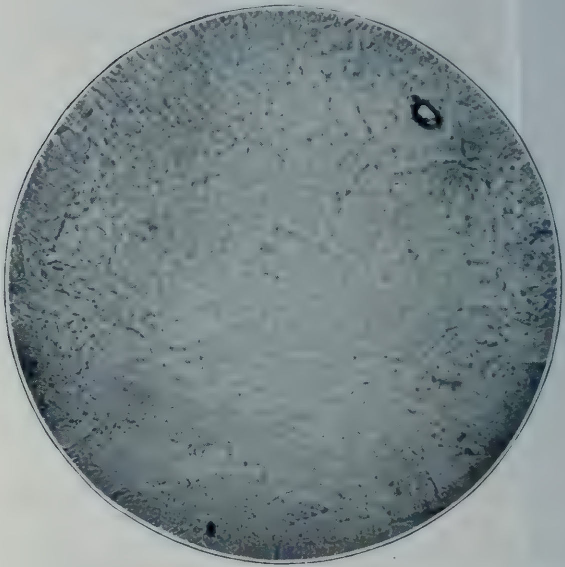

Fig. 2.—Content of the cyst under low magnification: cholesterol tablets and squamous epithelial cells.

cavity, simulating at times malignant growth, as, for instance, destruction of bony substance by otitic "cholesteatoma."

It would be better to make a clear differentiation between these two conditions. We could use the terms "true cholesteatoma" and "false" or "inflammatory cholesteatoma" or, better still, "cholesteatoma" and "cholesteatosis" (i. e., inflammatory). It is, however, not always possible to make a clean cut differentiation between the two conditions. Only in those cases in which we have a newly formed cyst cavity and wall can we be sure of the true neoplastic origin of a cholesteatoma.

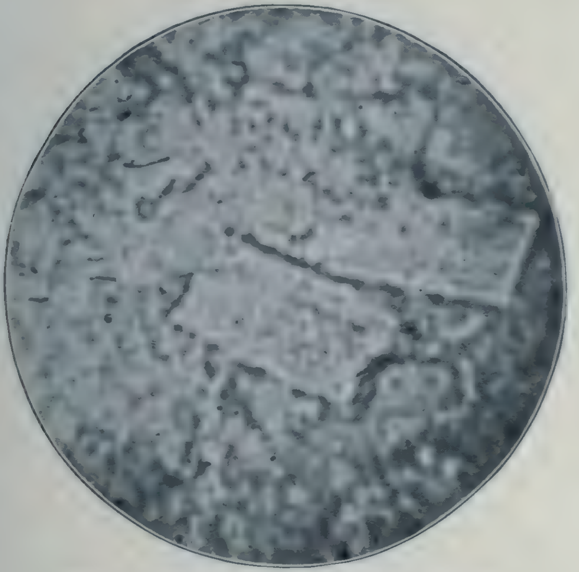

Fig. 3.—Content of cyst under high magnification.

As was mentioned, a close relationship exists between dermoid cysts and cholesteatomas (epidermoids). Occasionally in the cholesteatomas, hair is present with corresponding histologic findings. In the case reported here, some atypical glandular formations were present.

The essential features of our case are as follows:

REPORT OF CASE

History.—S. G. S., a white man, aged 31, was admitted to the hospital, Nov. 2, 1924, after he had been ill for twenty-four hours, complaining of diffuse abdominal pain, which seemed worse on the right side. There had been similar attacks every four or five months for the preceding two years. The patient stated that a full meal distressed him, and that opening his belt afforded some relief. The bowels were irregular, but regulation of the diet measurably controlled the situation.

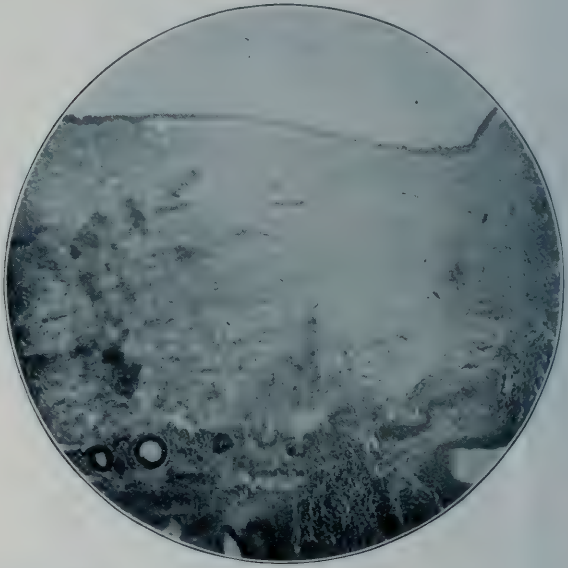

Fig. 4.—Wall of the cyst: above, epithelial lining; below and on the left side, glandular formations.

On admission to the hospital, the physical findings were fairly typical of an attack of appendicitis. A distinct tender mass was palpable between the border of the right rectus muscle and the anterior superior spine of the ilium.

Operation was undertaken for the removal of the appendix, which was found markedly inflamed and adherent by its distal extremity to what appeared to be a tumor encysted in the outer wall of the cecum. After the appendix had been removed, the cecal tumor was dealt with. The cecum was freely movable, and the tumor was enucleated without difficulty. The tumor cavity did not communicate with the lumen of the bowel. Excision of the redundant wall, or capsule, completed the operation. The patient recovered promptly, and shortly returned to his work—that of an insurance agent.

Laboratory Findings.—The specimen consisted of a loose, silvery white ball, 5 cm. in diameter, some silvery membranes loosely attached to the ball, and more of the same membranes separated from it, together with two small pieces of injected cyst wall.

The silvery content of the cyst consisted microscopically of hornifying, squamous epithelial cells and cholesterol tablets. These tablets did not dissolve practically at all in cold ethyl alcohol, but dissolved in chloroform, with formation of multiple droplets, which stained with sudan III.

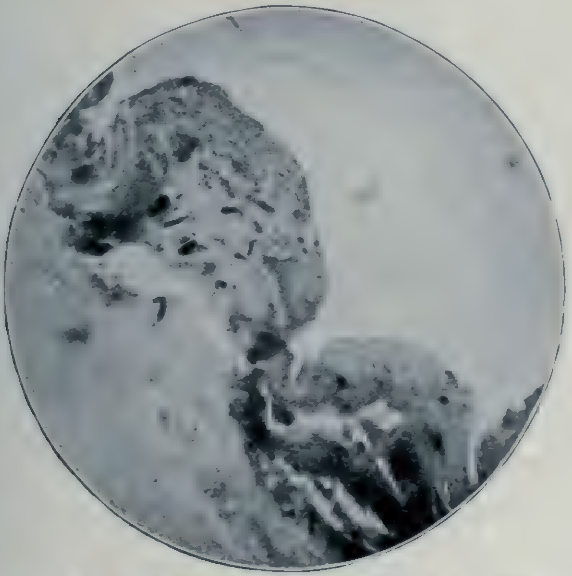

Fig. 5.—Wall of cyst: epithelial lining absent; in one place (in the center) there is an epithelial papilla.

As far as the histologic structure of the cyst wall was concerned, the epithelial innermost lining was preserved only in places, and consisted of two or three layers of squamous, flat epithelial cells separated from underlying connective tissue by a definite basal membrane. In one place an epithelial papilla very similar to those in skin epidermis was present in the deeper tissues; it consisted of from twenty to thirty sheets of malpighian cells, and seemed to be well limited by basal membrane. In other places the inner lining was formed by loose granulation tissue richly infiltrated with lymphocytes. About one third of these connective tissue cells were in a state of epithelioid transformation somewhat resembling tuberculous granulations. Some giant cells (foreign body type) were present, particularly in the superficial layers. No cholesterol deposits were seen. Very numerous small vessels supplied this loose tissue. In some places this inner layer had a more pronounced fibrous character.

The middle layer of the cyst wall consisted chiefly of fibrous tissue. Numerous foci of plasma cells or lymphocytic infiltration were seen here. Some glandular formations were present in this layer: cross-sectioned tubes outlined by three layers of columnar cells. The outer fibrous sheet was covered by the peritoneum; it contained numerous big vessels and multiple foci of lymphocytic infiltration.

COMMENT

Thus the microscopic examination confirmed the diagnosis of true cholesteatoma of the cecal wall. The typical content, as well as the presence of epithelial lining, was characteristic of tumors of this kind. Although some signs of inflammation were present (foci of lymphocytic and plasmocellular infiltration around the vessels and without visible connection with vessels) the condition could hardly be suspected to be of inflammatory origin. The inflammatory changes common to any tissue deposits of cholesterol played here but a secondary rôle. The neoplastic character was well pronounced, for there was a newly formed cavity between the serous and muscular sheets of the cecal wall, and this cavity was in no way connected with the intestinal canal. There were some peculiarities in the case when compared with cerebral cholesteatomas. The wall of this tumor was much thicker, and the blood supply was much more abundant. It depended evidently on the differences in the local conditions. It is obvious that a cyst will develop a thicker wall in the abdominal cavity than in the skull.

MESENTERIC CYSTS

BY

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CHICAGO

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MESENTERIC CYSTS*

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Since the 16th century, when a Florentinian anatomist, Benivieni,[1] first described mesenteric cysts as "anatomical curiosities" many papers have been published on this subject and about 300 cases reported. The questions concerning the histogenesis and histological structure are now resolved, nevertheless a clinical diagnosis has been made in only a very few cases. We believe the clinical diagnosis can be made more frequently if the surgeons when diagnosing an "abdominal tumor" will keep in mind the possibility of a mesenteric cyst. The great majority of these cysts are located in the mesentery of the small intestine; only about 10% of them, namely, about 30 cases of those reported, were connected with the mesentery of the colon. Because of this fact we think that our case of cyst of the mesentery of the ascending colon presents some interest.

Mr. R. H. Q., 37 years of age, married and the father of three children, entered the West Suburban Hospital on December 24th, 1924, complaining of acute abdominal distress of 24 hours' duration. The pain was not extreme but the patient had been compelled to unfasten his belt on account of the tenderness to pressure. There had not been vomiting. The temperature was normal and the white blood count was not disturbed. Physical examination was negative except for the abdomen, which was tender throughout. The right side showed the greater tenderness and there was a distinct mass under the right rectus muscle on a level with the umbilicus.

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*From the West Suburban Hospital, Oak Park, Ill.

The previous history revealed dyspeptic symptoms and a number of similar attacks which on two occasions had led to a diagnosis of appendicitis. The patient had never suffered any serious illness and while in college took a leading part in athletic games, notably baseball. A few months before his admission to the hospital there had been a thorough x-ray examination of the intestinal tract with negative findings. The history, together with the physical examination, appearing to justify the diagnosis of a surgical condition, operation was undertaken having for its objective the mass beneath the right rectus abdominis. Upon opening the abdomen it was at once apparent that the patient was not suffering from any acute inflammatory process. The appendix was not involved and all other viscera seemed normal. However, a bluish red mass 5 centimeters thick was protruding medially from beneath the ascending colon well up toward the hepatic flexure. A constricting ring marked the point where the mass had broken through. Further examination showed the tumor to be a multilocular cyst with thin walls and all subdivisions to be filled with blood. A portion of cyst wall was removed for microscopic examination. Drainage of the many subdivisions of the cyst not appearing feasible, the abdomen was closed without drainage. This treatment seemed advisable on account of the suspicion of malignancy. Fortunately this suspicion has proved unfounded.

By microscopical examination cystic content—

a bloody fluid—consists of numerous red blood cells. This fluid does not clot spontaneously.

The walls of the cyst consist of fibrous and fat tissue which are covered with one sheet of flat endothelial cells. Foci of lymphocytic infiltration around the vessels; some eosinophiles are seen also.

Diagnosis: Multilocular mesenteric cyst of lymphatic origin (Lymphangioma multiloculare).

In the history of the study of mesenteric cyst, the date 1900, when Dowd[2] published his classification, is of great importance; he started the period of histogenetic study. Since then the papers of Niosi,[3] Colmers,[4] Friend,[5] Chomsky,[6] Istomin,[7] have been published on this subject and some new types of mesenteric cysts discovered; and now we have enough material to build up a rational classification of mesenteric cysts and solid tumors of the mesentery. Such attempts were made recently also by Forster[8] and Carter.[9] A very important point in this classification is the separation of false cysts, resulting from inflammation from the true neoplastic cysts.

Classification of the mesenteric tumors:[10]

INFLAMMATORY TISSUE GROWTH

- Pseudocysts
  - Retention
  - Hemorrhagic
  - Lymphorrhagic
  - Softening of lymph glands
  - Echinococci
- Solid tumors
  - Tuberculous lymphoma
  - Amyloid tumors

TRUE TUMORS

- Embryonic cysts
  - Lymphatic
  - Coelomic
  - Urogenital
  - Intestinal (Enterokystomata)
  - Dermoids
  - Cystic degeneration of solid benign and malignant tumors
- Solid tumors
  - Benign: fibroma, myoma, myxoma, lipoma, ganglioneuroma.
  - Malignant: sarcoma, primary carcinoma (very rare)

The old names such as "Chyle," "Blood," etc., cyst are dropped out by modern investigators. The content of a cyst is usually not characteristic and can undergo various changes. Only the histological structure of the wall reveals the nature and origin of the cyst.

When a mesenteric cyst is found, the following points are of great importance:

Localization. Attention must be paid to the connection with the pancreas, gastrointestinal tract (enterokystomata, outer solid tumors of the intestinal walls) or retroperitoneal organs. Numerous adhesions arouse the suspicion of an inflammatory condition. Presence of a zone of distended lymphatics is characteristic of a retention lymphatic cyst. Thickness of the wall is of great importance; it is uniform in true cysts and irregular in the softened solid tumors.

Inner Lining. Smooth inner surface is seen in the urogenital and lymphatic cysts; mucous membrane is present in the enterokystomata; rough surface, covered with attached fibrin is typical of cystic softening of myoma or other solid tumors. Many cavities (multilocular cyst) were observed in the lymphangioma (as it is in our case), some retention cysts, unrogenital cysts of ovarian cyst type and also in the softened solid tumors. In the last case the septa are usually thick and rather rough.

Content is typical only in dermoids, echinococci and occasionally in the enterokystomata (meconium). Chemical analysis of the cystic fluid is of no importance, save in pancreatic cysts (ferments). Microscopical examination of the contained cellular elements is of some significance, permitting sometimes the conclusion about endothelial (lymphatic or coelomic cysts) or epithelial (other forms) nature of the cyst. When a complete enucleation of a cyst is impossible, microscopic examination of the lining is of great importance. As far as we know, not a single case of malignant cyst with endothelial lining has been reported. In the presence of an epithelial lining, possibility of malignancy in a small percentage of cases must be considered. In Heyerowsky's case,[11] drainage of the cavity of a mesenteric cyst resulted in carcinomatous degeneration.

Fixation of the specimen must be performed as soon as possible after the operation because of post-mortem changes, desquamation and disintegration of the epithelial lining. By the microscopical examination particular attention must be paid to all thickenings of the wall. In these places some cellular formations can be found which reveal the point of origin of the tumor.

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GASTRIC SYPHILIS; A REPORT OF TWO CASES PROVED ANATOMICALLY[1]

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ACQUIRED syphilis of the stomach, anatomically proved, may be considered a rare disease if one is to judge the incidence by the number of reports of such cases in the literature. Thus, we were unable to find more than 14 cases in which the anatomical reports were sufficiently complete to warrant a diagnosis of gastric syphilis. Among those usually accepted as proved syphilis of the stomach are the cases of Flexner (6), Hemmeter and Stokes (11), Fraenkel (8), Curtis (16), Chiari (23), Klebs (66), Cornil and Ranvier (67), Weichselbaum (68), Birch-Hirschfeld (69), Stolper (64), Buday (13), Sparmann (70), and McNee (71).

This rarity may, however, be more apparent than real for the modern methods of specific treatment have undoubtedly cut short the course of tertiary syphilis in the stomach as elsewhere in the body. Another reason may be that the condition may have been mistaken at the operating or postmortem tables for carcinoma or chronic calloused ulcer of the stomach.

This supposition is supported to a certain extent by the fact that the number of cases of gastric syphilis reported and in which the diagnosis was based solely on clinical or serological evidence has been much greater, especially in the past few years. The exact number of such reports cannot be given but a fair estimate would be about 250.

On the other hand, we must not be led into making a diagnosis of gastric syphilis simply because there is a digestive disturbance coexisting with a positive Wassermann or evidence or a history of syphilis elsewhere in the body. Such a coincidence may be purely accidental especially if we consider a verbal statement made by Professor Finger that about 10 per cent of the population of Vienna would give evidence of luetic infection in the form of a positive Wassermann, history or symptoms of lues. This figure may not apply in certain instances but the example is well worth remembering.

It is, therefore, with the view of emphasizing the clinical and anatomical characteristics of gastric syphilis that these two cases of anatomically proved lues of the stomach are reported.

Case 1. E. G., female, white, age 25, married, was admitted to the Cook County Hospital on July 7, 1922. The patient's family history was negative; she had never been pregnant, and she denied venereal infection. She was well up to about 3 months ago when she began to complain of dyspnœa, palpitation, swelling of the ankles, pain in the chest and abdomen, and marked loss of weight.

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[1] Read before the Chicago Surgical Society, April 6, 1923.

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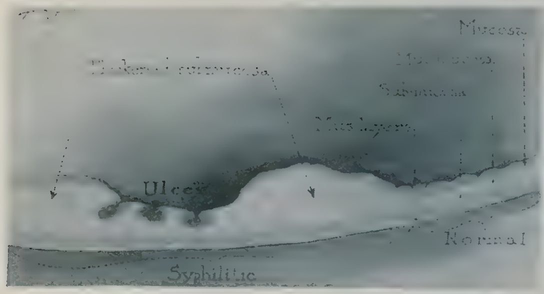


Fig. 2. Cut section of specimen removed from Case 2 showing thick submucosa and shallow ulcer.

The abdominal pain was in the midline, dull or aching, came on about 5 minutes after eating and lasted for about half an hour. Bowel movement had no effect on the pain. The pain soon became more constant but was still worse after meals regardless as to whether she took liquids or solids. Alkalies had no distinct effect and vomiting was the only thing which relieved her. Bodily motion did not increase the pain nor did it radiate in any direction. She lost about 25 pounds in the first 2 months and a good deal more in the following month. She was dizzy at times and frequently had nausea.

Vomiting occurred for the first time about 2 months ago and was chiefly after meals. Large quantities of a bitter, dark brown substance were vomited but never any blood. She also had eructations and belching. She soon noticed that her abdomen became large and that she could induce vomiting by pressing on her epigastrium. She did this to relieve the pain. Anorexia and constipation were also present but there was never any jaundice.

The examnation showed a poorly nourished female, very much emaciated and very ill. The pupillary reflexes were normal, and there were signs of a double mitral lesion and aortic insufficiency. The reflexes were normal and the urine contained a trace of albumin and a few hyaline casts. The Wassermann of the blood was strongly positive.

There was a tender bulging in the right hypochondrium, and pressure over this produced vomiting. A sausage-shaped mass was palpated in the epigastrium. Aspiration of the stomach contents caused the bulging to disappear and inflation of the stomach again brought out the tumor.

Examination of the stomach contents after an Ewald meal showed 600 cubic centimeters of residue; free hydrochloric acid 0, total 30; some mucus and occult blood. The stools were tested four times for blood under the usual precautions and with the benzidine test, and were positive in all instances. There was a leucocytosis of 15,100.

X-ray examination showed a large 6-hour residue and no barium had entered the bowel. Only the proximal part of the stomach showed a shadow with a blunt interruption at the pars media. Rotation of the patient to a semi-prone position aided the remainder of the stomach to fill, but the pars media did not fill out even with this change in posture.

Syphilis of the stomach was suspected, but there was also a strong suspicion that the condition might be malignant. She was operated upon for the existing obstruction and for a possible resection of the involved part. About one-third of the stomach was resected, including the entire infiltrated pyloric portion, and a Billroth II operation was performed as there were no adhesions and the adjacent glands were but slightly enlarged. She was also placed on specific treatment. The patient was seen about 2 months after operation. She felt well and had gained 30 pounds.

The anatomical features of this case will be discussed together with those in Case 2, except to point out the differences which were only in degree of the same changes.

CASE 2.[1] J. M., male, age 51, married, clerk. Admitted to the Allgemeines Krankenhaus, Vienna on November 26, 1920. Family history negative. Patient had chancre on penis at age of 25 which was treated as syphilis, but for a short time. Digestive disturbances began about 3 years after infection and consisted of burning pains in the epigastrium with radiation upward. The pain came on about an hour and a half after meals and lasted about 4 hours. Occasional pain occurred at midnight and could not be relieved by any measures.

Vomiting was infrequent at first but later occurred daily. The vomitus was about 500 cubic centimeters and contained food but no blood or retained stomach contents. Vomiting was the only thing which relieved the pain in the later stages. Anorexia, constipation, and marked loss of weight were also noted.

Examination showed a markedly emaciated male, no fever, and no abnormal findings in the chest. Ewald test meal, removed 25 minutes after ingestion, showed: quantity, 150 cubic centimeters; free hydrochloric acid 0, total acidity 2; no blood or lactic acid. The abdomen was tender in the upper part but no tumor was palpated. The knee jerks were absent and he had an Argyll-Robertson pupil.

X-ray examination showed a 6-hour residue of about half of the barium meal. The stomach was normal in position, not dilated. There was pyloric insufficiency. The pyloric portion resembled a narrow canal about as thick as a lead pencil and with ragged margins. No tenderness was present at the pylorus or duodenum and the latter had normal outlines. The condition was thought to be carcinoma. The pyloric portion was resected and a Billroth I operation performed.

A Wassermann taken after operation was strongly positive. The stools were examined for blood but the results were indefinite. The diastase content in the serum, urine, and stools was normal, and there was a white count of 29,600.

[1] Reported in Arch. f. Verdauungskr., 1921, xxvii, Sept. 6.

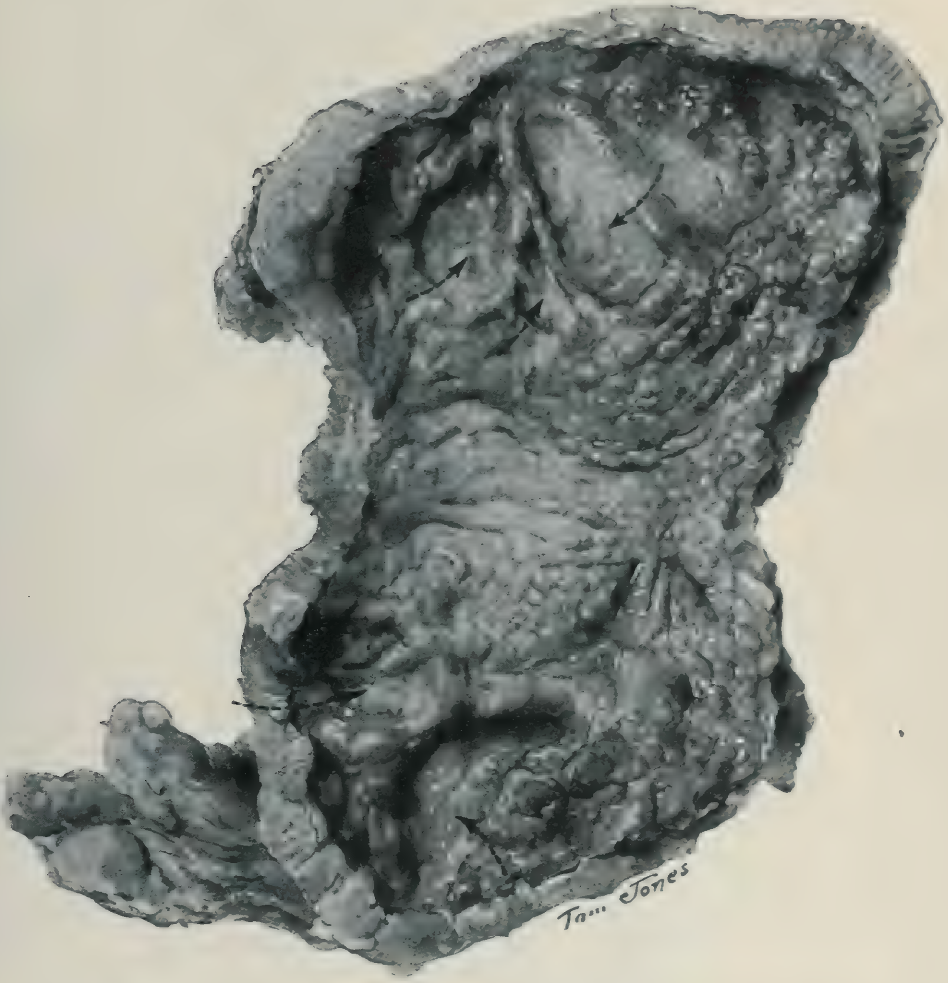
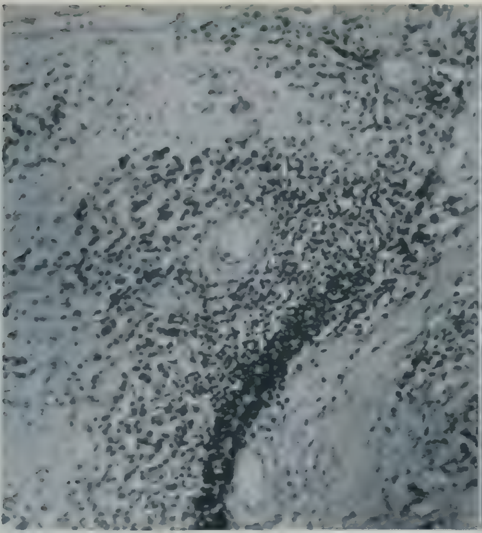


Fig. 1. Resected pyloric portion of stomach from Case 1. Walls thickened and five ulcers indicated by arrows.

Gastric Syphilis; a Report of Two Cases Proved Anatomically.
—William A. Brams and Karl A. Meyer.



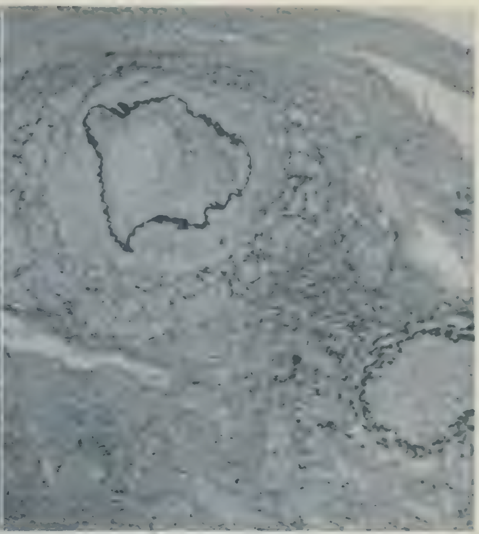


Fig. 3 (at left). Perivascular infiltrate consisting chiefly of lymphocytes and a few plasma cells. Hæmatoxylin-eosin stain.

Fig. 4. Pan-arteritis and pan-phlebitis with complete obliteration of lumen of vein and almost complete obliteration of the arterial lumen. Marked change in the adventitia of the artery. Weigert elastic tissue stain.

The anatomical features of the resected specimens showed the characteristic changes which allowed a strongly presumptive diagnosis to be made at once. These were the *thickened submucosa; shallow, multiple, and irregular ulcers*, and the presence, in Case 2, of visible *miliary gummata*.

The entire pyloric portion of the stomach was thickened and infiltrated. Case 1 showed 5 shallow, irregular ulcers on the anterior and posterior walls, while Case 2 had only 3 such ulcers on the posterior surface. The maximal diameters of the smallest ulcer were 15 by 5 millimeters and 35 by 10 millimeters in the largest. The average depth was 2 millimeters and the comparatively smooth, dark red base stood out in relief against the pale gray surrounding mucosa. The margins were somewhat raised and thickened but there was no necrosis or caseation anywhere.

The cut section showed the submucosa to be thickened to about eight times its normal size in the region of the ulcers and normal beyond them. This layer was pearly gray, of rubbery consistency, and Case 2 showed small pinpoint miliary gummata. At no place in either specimen did the ulcer go deeper than the more superficial part of the submucosa.

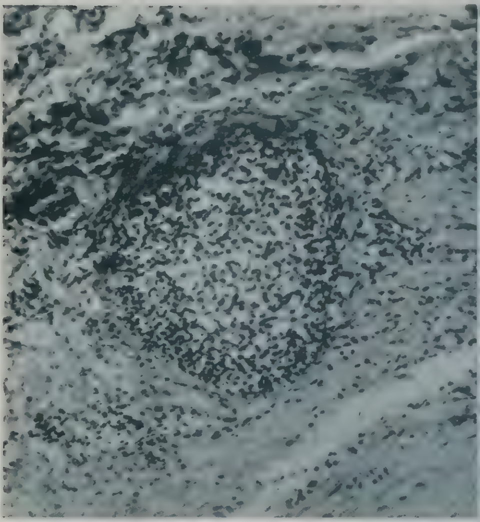
Numerous slides were stained with hæmatoxylin-eosin, Weigert, Van Gieson and stains were made for bacteria with Gram and methylene blue. and stains for tuberculosis bacilli were made. The Levaditi method was used in the search for the treponema pallida.

The microscopic examination showed that all of the important changes were chiefly in the submucosa and that the thickening of this layer was due to the connective tissue proliferation, round cell infiltration and œdema. It was the œdema which was the principal factor in the thickening of the submucosa in Case 2.

The chief features seen on microscopical examination were:

Perivascular infiltrate which consisted chiefly of lymphocytes and a few plasma cells. There were many vessels involved in this manner, regardless of size, and both the veins and arteries were affected. Case 2 differed in that the vessels which showed changes in their walls were not so often seen to have this perivascular infiltrate.

Pan-arteritis and pan-phlebitis, described by Fraenkel and considered by him to be highly characteristic of this condition, if associated with such other changes as an infiltrate,



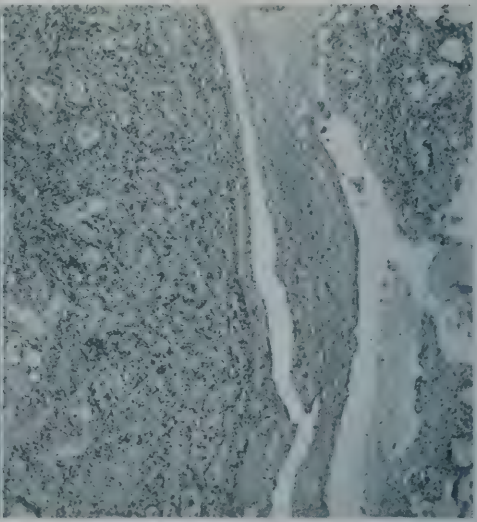


Fig. 5 (at left). Miliary gumma in muscular layer consisting of lymphocytes and a few plasma cells on a framework of delicate connective tissue and containing a few capillaries. Some epithelioid cells near periphery. No necrosis or caseation.

Fig. 6. Ulcer base showing diffuse infiltrate of lymphocytes and coat of fibrin enclosing some leucocytes and débris.

etc., were present. The process evidently began in the outer layers of the vessels and then attacked the media and intima. The earliest changes were a teasing apart of the elastic fibers of the adventitia with infiltration by round cells. The media was next affected and then the intima but this layer did not show the tearing apart of the elastic fibers to the same degree as did the adventitia. Fibrosis then occurred and the vessel became permanently changed. The lumen became narrowed and in many instances completely obliterated during the stages of infiltration and fibrosis. It is interesting to note that the vascular involvement was in patches and did not affect the entire circumference. The changes in the veins were probably the cause of the marked œdema of the submucosa, but it is curious that there was no necrosis in the presence of the extensive arterial changes. The pan-arteritis was not so marked in Case 2, and only a moderate degree of endarteritis was present in this case, but not any more than in ordinary peptic ulcer or in the vicinity of any other chronic inflammation.

Both specimens contained miliary gummata, the number in Case 2 being much greater than in Case 1. These were located chiefly in the submucosa but some were present in the muscular layers as well. This change consisted of a circumscribed collection of cells, chiefly lymphocytes but also a few plasma cells at the periphery. Both elements rested on a fine connective-tissue framework and an occasional capillary was seen within the gumma. The whole was surrounded by a thin connective-tissue capsule but there was no marked vascular reaction in the vicinity nor were there large vessels near by. This was quite distinct from the other forms of infiltrate, and no necrosis or caseation was present. A few epithelioid cells were present near the periphery, and Case 2 showed one with a giant cell of the Langhans type.

The diffuse infiltrate consisted chiefly of lymphocytes and a few plasma cells with an occasional giant cell. A few polynuclears were present near the surface. The infiltrate was very extensive and was found chiefly at the base of the ulcer. There were many capillaries and a number of extensive hæmorrhages, especially near the mucosa. This collection of free blood was seen at one place to lift off the overlying mucosa. This may have been one of the factors in the formation of the ulcer.

Other and less important changes were a round-cell infiltration of the interstitial tissue of the mucosa with occasional hæmorrhage. A coat of fibrin containing some leucocytes and débris covered the base of the ulcer. The muscular layers showed evidences of fibrosis and slight round-cell infiltration, and the peritoneum was practically normal. Both specimens showed an occasional round-cell infiltration around the nerves in the muscular layer. This may, perhaps, be one of the causes for the pain.

A careful search was made for spirochætæ but none was found. This does not speak against the diagnosis, as it is well known that the causative organisms are seldom found in tertiary lesions. McNee (71) described changes very similar to those in these specimens and in which he demonstrated spirochætæ in the submucosa very closely resembling the treponema pallida.

There were a few long, Gram positive bacilli and Gram positive cocci at the surface of the ulcer but no tuberculosis bacilli were found.

A study of 135 additional cases selected from the literature was then undertaken with a view of establishing a clinical picture. This series included the 14 cases proved anatomically and those in which the diagnosis, when based on clinical findings alone, seemed fairly certain.

According to Bensaude (72), there are four types: ulcerative, tumefactive, linitis type, and stenosing type. The nature of the underlying pathology will determine the type and the resulting symptoms, but there are clinical manifestations which are common to all forms and which will be briefly described.

Pain in the epigastrium with occasional radiation was present in all but three instances (29, 73, 74) and was the most frequent and important symptom. It was usually severe and became worse after meals, but all varieties and degrees were noted. The pain was at first relieved by alkalies but subsequently only vomiting gave relief. The most frequent type was boring or burning and it was constant in many instances.

Anacidity and marked *subacidity* were found in 80 of the 93 instances in which the stomach contents were examined and reported. This was present in both of our cases.

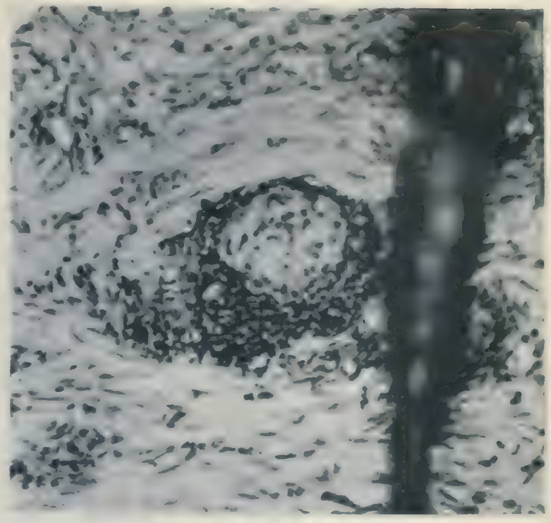


Fig. 7. Perineural infiltrate of round cells in muscular layer.

Emaciation was usually marked, the average loss being from 30 to 40 pounds, and one author reported a loss of 75 pounds. This sign was present in 88 per cent of the cases. A marked anæmia often accompanied the emaciation and often gave rise to the impression that there was cachexia.

It is difficult to determine the actual rate in which there was *evidence of luetic infection*, as many of the cases were reported in the days before the Wassermann came into use. The Wassermann test was reported in 89 cases and was positive in 96 per cent, the great majority being 4+. There were 9 additional cases in which no Wassermann was reported but in whom positive evidence of syphilis was found. Two instances are reported in which the Wassermann was negative in spite of the fact that the condition was syphilis, as proved by other clinical evidence and the results of specific treatment (75, 76).

Reaction to *specific treatment* is especially characteristic if previous management has failed. There were 125 reports in this regard and the results were: clinical cure in 60 per cent, improvement in 33 per cent, and failure in 7 per cent. There were some cases in which the contour of the stomach, as seen on X-ray examination, returned to normal and a few instances in which a previously anacid gastric juice returned to normal after specific treatment.

The findings on X-ray examination varied to a great extent and were usually very much like those found in carcinoma. Signs of obstruction and filling defects were the chief features, but it is difficult to point out changes which are pathognomonic of syphilis.

The other and less characteristic symptoms were hæmatemesis, constipation, vomiting, tenderness in the epigastrium, large liver and blood in the stools. These were not found in a sufficiently large number of instances to warrant particular attention as characteristic of gastric syphilis.

RÉSUMÉ

The clinical evidence of gastric syphilis consists of pain in the epigastrium, low acidity, marked emaciation, history or evidence of luetic infection, and a good result with specific treatment. To this should be added that the patient is often under the usual age for carcinoma and that the course is often over a period of years.

The anatomical features are multiple, irregular ulcers; thick submucosa; vascular changes; miliary gummata; perivascular infiltrate; and diffuse infiltrate, in which the predominating element is the lymphocyte.

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A Study of Acute, Primary Typhlitis

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A STUDY OF ACUTE, PRIMARY TYPHLITIS *

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Few physicians fail to consider the vermiform appendix as the first and most probable cause of acute disease in the lower right portion of the abdomen. However, we sometimes overlook other conditions in this region, one of which is acute, primary typhlitis. Acute, primary typhlitis is but little mentioned in the ordinary textbooks, and we were able to find only sixteen cases reported in the literature in which the condition was found anatomically, either at operation or at necropsy, and without primary involvement of the appendix or adjacent tissues.

The recognition of acute primary typhlitis is of the greatest importance, however, after the abdomen is opened, as it is practically impossible to distinguish clinically between this condition and acute appendicitis with our present methods of examination. This is amply illustrated by our two cases, in which the diagnosis of acute appendicitis was made and in which immediate operation was performed. The finding of a free and apparently normal appendix in the presence of pus in the right lower quadrant of the abdomen after the peritoneum was opened proved at first somewhat puzzling, but careful search for the primary cause of the peritonitis resulted in the discovery of gangrenous and ulcerated areas in the cecum, in one of which the lesion was apparently due to the presence of a foreign body.

REPORT OF CASES

CASE 1.—S. H., a man, aged 19, was admitted to the surgical service of the Cook County Hospital, July 17, 1924, com-

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* From the Department of Surgery, Cook County Hospital.

plaining of severe pain in the right lower quadrant of the abdomen, which came on suddenly while he was at work. The pain was located at McBurney's point and did not radiate. Vomiting occurred several times on the day after the onset of the pain, and moderate constipation had been present since the onset of the illness. The symptoms showed no signs of abating two days after their onset, at which time the patient entered the hospital. There was nothing of importance in the past history. Examination revealed marked tenderness and rigidity of the right side of the abdomen, and especially in the right lower quadrant. Rectal examination showed some tenderness on the right side, but no mass was palpated. Physical examination of the rest of the body showed nothing abnormal. The urine was negative, the white blood count was 16,000, the temperature 100.2 F., the pulse 72, and respirations 22 a minute.

A diagnosis of acute appendicitis was made, and the patient was immediately prepared for operation. Under ether anesthesia a Battle incision was made, and about a pint of foul smelling fluid escaped as soon as the peritoneum was opened. The pus apparently came from the region of the cecum and pelvis. The pus and fluid were sponged out with dry gauze swabs, and the appendix was brought up. The appendix was free and uninvolved, but examination of the cecum revealed a perforated ulcer about half an inch in diameter and situated on the anterior wall of the cecum. The region of the cecum in the vicinity of the perforation was gangrenous, and several smaller, blackish areas were present at varying distances from the perforation. The perforation was closed with three rows of linen, and the appendix was removed. The peritoneum was closed tightly and a small gutta-percha drain was left in the superficial tissues up to the peritoneum. The patient was then placed in Fowler's position, local heat was applied to the abdomen, and 6 ounces (175 c.c.) of warm physiologic sodium chlorid solution was given by rectum every four hours. The patient made an uneventful recovery, and was discharged as cured sixteen days after the operation.

Case 2.—J. P., a man, aged 33, admitted to the surgical service of the Cook County Hospital, June 13, 1924, awoke, twenty-six hours before, with a severe pain in the right half of the scrotum. Four hours after the onset of the pain, it shifted to the region of the umbilicus and became diffuse two hours later. The pain was most intense over the lower right portion of the abdomen, and was relieved by drawing up the right thigh. The patient did not vomit spontaneously, but induced vomiting after the pain began. The pain did not radiate. The bowels were regular, and the patient had never before had "stomach trouble."

The patient was acutely ill. The temperature, 103 F.; pulse, 108, and respirations, 22. He kept his thighs drawn up. Tenderness and rigidity were present all over the abdomen, but were especially marked in the right lower quadrant. Peristaltic sounds were diminished, but the area of liver dulness was normal. Rectal examination showed tenderness on both sides, especially on the left. There was no tenderness or swelling of the genitalia. The white blood count was 15,000, and the urine was negative.

A diagnosis of acute appendicitis was made, and the patient was immediately operated on. A mass could be palpated in the right lower quadrant of the abdomen after the peritoneum was opened. A large quantity of foul smelling fluid escaped from the pelvis. The appendix was free and easily brought up, and examination showed it to be slightly thickened and reddened but not enough to account for the pus and peritonitis. Examination of the cecum showed three perforated ulcers on the anterior wall of the cecum and about 1½ inches from the ileocecal valve. A large nail, covered by hard feces, so that the entire foreign body measured about 1½ inches by three-fourths inch protruded from one of the ulcers that was perforated. An incision was made connecting the three ulcers, and the foreign body was removed through this enlarged opening. The entire area was then invaginated and closed by three rows of linen sutures. The pus was sponged out with dry gauze, the appendix removed, and the peritoneum closed tightly. The superficial tissues were treated as in Case 1, and the patient received the same after-treatment. Recovery was uneventful, and the patient was discharged as cured five and a half weeks after the operation.

COMMENT

From a study of our cases and those reported in the literature there seems no doubt that there are sufficient clinical and anatomic data to establish the fact that acute primary typhlitis may exist as a primary disease, independent of and not secondary to a general dysentery or to disease elsewhere in the vicinity of the cecum. It is not our intention, however, to renew the old controversy of appendicitis and typhlitis, as we are convinced that it is practically impossible with our present methods of examination to distinguish clinically between the two conditions. The clinical differentiation between the two conditions is also of minor importance in view of the fact that the treatment for both conditions is immediate operation; and it is our opinion that no time should be lost in attempting to distinguish between them before operating. A knowledge of the condition under discussion is of value after the peritoneum has been opened, as it enables the surgeon to look for the causative disease and to deal with it promptly without greatly disturbing the surrounding structures, a procedure highly desirable in the presence of pus in the peritoneal cavity.

SUMMARY

1. Our two cases, and those reported in the literature which were proved anatomically, offer sufficient evidence that acute primary typhlitis may occur as an independent and primary disease without being secondary to disease of the appendix or neighboring structures.

2. It is practically impossible to differentiate clinically acute primary typhlitis and appendicitis; and since the treatment for both conditions is immediate operation, we are of the opinion that no time should be lost before operating.

3. The importance in recognizing acute primary typhlitis manifests itself after the peritoneum is opened and pus found in the free peritoneal cavity, and an appendix that is apparently free and normal.

31 North State Street—Cook County Hospital.

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FRACTURES OF THE BASE OF THE SKULL*

Involving the Frontal Sinus or Mastoid Antrum

By Cassius C. Rogers, M.D., F.A.C.S.

CHICAGO, ILLINOIS

Mr. President and Members of the Society:

Let us consider for a few minutes the contents of the cranial cavity and the causes of death when these structures are injured. The cranial cavity is just large enough to hold its normal contents, and anything added in the way of edema will cause symptoms. The brain is essential to life and health, and, like all living tissue, must be nourished by blood if it is to maintain its normal function. A brain devoid of blood dies the same as any strangulated tissue, and if normal function is to be maintained the strangulation must be relieved.

The brain normally is bounded by two nonelastic structures, the dura mater and the firm bony structures. To relieve intracranial pressure one or both of these structures must be opened or removed.

The real cause of death following injury to the brain is anemia. This anemia is due to intracranial irritation, causing edema. This, in turn, produces sufficient pressure to force out the blood and cerebrospinal fluid, and death is the result.

The irritation in cases of fracture of the base of the skull is usually an infection secondary to infection of the frontal sinus or the mastoid antrum.

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*Presented before the Sioux Valley Eye and Ear Academy, meeting at Sioux City, Iowa, January 19, 1925.

It then must be our aim to prevent infection, and how can this be done? Not by "watchful waiting" to see what is going to happen. The old treatment, absolute rest with icebag or icebags to the head, must give way to a more sane and scientific treatment so that more satisfactory results can be obtained.

If we are going to keep abreast of the satisfactory results obtained from the treatment of injuries in other parts of the body, we must lower the death rate in fractures of the base of the skull.

A fracture of the base is usually associated with a fracture of the vault. I think we will all agree that a depressed fracture of the vault is always surgical, and that the depression should be relieved by raising the skull or removing a portion of it entirely. But we are far from one opinion when it comes to treating fractures of the base of the skull.

Fractures of the base of the skull are either transverse or longitudinal. Transverse fractures are located in either the anterior, middle, or posterior fossa. The most common one is that of the middle fossa, running transversely through the mastoid antrum and mastoid cells on to the vault. This is accompanied usually by the escape of blood and cerebrospinal fluid from the external ear or the mouth.

The longitudinal fracture extends from the foramen magnum, running forward through the jugular foramen, breaking off the tip of the petrous portion of the temporal bone, running forward not in the median line but to one side of the crista galli into the frontal sinus, and then on to the vault. This fracture is associated with the escape of cerebrospinal fluid from the nose.

When a person has received an injury, and upon examination we find the escape of blood or cerebrospinal fluid from the ear, nose, or mouth, the patient has a fracture of the base of the skull, without any exception.

An *x*-ray examination should always be made, but if the report is negative it becomes only a matter of history. The eyes and ears should be examined by a competent ophthalmologist and otologist. If his report is negative it should not influence us in our firm belief that the patient has a fracture of the base of the skull.

These fractures are always compound, and a closed cavity is now directly exposed to a cavity containing air; the frontal sinus and the mastoid antrum contain blood, which becomes clotted; this, in turn, produces an irritation with edema, and the normal openings from the frontal sinus into the nose and from the mastoid antrum into the ear become occluded. The blood clots in these cavities become infected, and there is a typical frontal sinusitis or mastoiditis.

The direction of least resistance is now toward the cranial cavity, and the infection will travel in that direction and a meningitis is the result, which is frequently followed by death.

If we are going to obtain satisfactory results in these cases it must be our aim to prevent infection rather than to combat it after it is present.

It is with pleasure that I bring this subject before you, a body of specialists, as you are skilled operators upon the frontal sinus and the mastoid.

I am thoroughly convinced that all that is necessary to prevent the extension of infection from these cavities is to drain them as soon as possible after the injury has occurred and the diagnosis has been made. The frontal sinus should be opened externally, the blood clot evacuated, and the sinus drained. Drainage through the nasal cavity will not suffice.

If the mastoid antrum or cells are filled with clotted blood, the antrum and cells must be drained by a typical, simple mastoid operation. A plate of skull at least two inches in diameter just above the antrum and attic must be removed, and no attempt made to replace it. The lateral sinus should be exposed but never opened.

The dura mater should never be opened in either of these operations if they are done early.

Again let me bring before you as forcibly as possible that no time should be lost in draining these cases after the diagnosis is made. Twelve hours should be the limit unless there is some grave reason for delay, and twenty-four hours should never elapse if we are going to operate these cases and expect to get the most satisfactory results.

After basilar meningitis has developed operative interference is of little value.

Lumbar drainage is always contra-indicated to relieve intracranial pressure due, directly or indirectly, to fracture of the base of the skull. It is doubly contra-indicated if an infection has already manifested itself.

THE PLACE OF ELECTIVE VEIN LIGATION IN BLOOD-VESSEL SURGERY

By R. W. McNEALY, M.D., Chicago

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THE PLACE OF ELECTIVE VEIN LIGATION IN BLOOD-VESSEL SURGERY[1]

By R. W. McNEALY, M.D., Chicago

IT is safe to say that previous to 1913 every surgeon considered that simultaneous ligation of a large vein and artery in the same extremity added greatly to the likelihood of ensuing gangrene. About 1913 Makins' (9) attention was attracted by the occurrence of gangrene in a large percentage of the cases of arteriovenous aneurism of the femoral artery in which proximal ligation was done, while excision of the aneurism and quadruple ligation was followed by good results.

In 1913 W. A. Oppel (11) published the results of several cases of popliteal vein ligation alone in cases of threatened gangrene of the foot. He was led to adopt this procedure from observations of the good results which occurred in some cases of arteriovenous anastomosis. These good results he believed to have been due almost wholly to the retarding of the venous return with a consequent rise in capillary blood pressure of the extremity.

Lidski (8) in the same year reported three threatened gangrene cases treated by vein ligation with satisfactory results in two.

In 1917 M. Van Kend (12) carried on some animal experiments at the Ocean Ambulance at

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[1] This work was done in the Specializing Service of the Cook County Hospital. Read before the Chicago Surgical Society, March 6, 1924.

LaPanne and presented the following observations to the Interallied conference of Surgeons held in Paris: "It appears then from the standpoint of the physiologist that to leave the main vein viable after occlusion of the main artery of a limb, diminishes what may be called the residuary blood pressure maintained by the collateral circulation. If the contribution of the collateral circulation is allowed to remain with the main vein intact, it is natural that the residuary blood pressure should fall. If this view be adopted, ligature of the vein as well as artery should be recommended in order to retain the blood supplied in longer contact with the tissues. Thus the most satisfactory conditions for maintenance of the nutrition of the organs are provided, because the obstacle to the return circulation provided by ligature of the vein retains the blood for a longer period in the member." Following Van Kend's remarks the following conclusion was adopted by the conference: "Contrary to what has until now been believed, simultaneous ligature of both artery and vein when both vessels have been wounded does not give rise to increased risks of gangrene; in fact it diminishes them. Facts tend to prove even when the wound is limited to the artery that simultaneous occlusion of the unwounded vein is to be recommended."

Hamilton Drummond (4) worked with loops of small intestines of cats and found the same principle to apply to intestinal vessels. Larger areas of gut became gangrenous when the artery alone was ligated than when both artery and accompanying vein were ligated.

At this point let us consider a few points in the physiology of the circulation. The vitality of a part depends upon its blood supply, and the blood supply to a given part depends upon the volume and character of the blood, the rate and propulsive power of the heart, the size and number of the supplying arteries, and the size and number of the returning veins. Metabolic activity of the tissues and the rhythmic contractions of the capillaries have a very important place in the stability of the blood supply.

When one or a number of arteries to a part are occluded, certain changes take place: (1) The amount of arterial blood to the part is lessened. The extent of the diminution will depend upon the number and completeness of the occlusion and the richness of the collateral circulation. (2) The tissues are deprived of their nutrition because the interchange of substances through capillaries is much reduced. (3) The capillary area is greatly diminished by a collapse of a large number of capillaries. (4) Rhythmic capillary contractions are probably little interfered with unless deprived of circulating fluid for a considerable period. (5) The venous return is altered only to the extent of the lessened pump action of decreased muscular activity. (6) The tidal flow is obviously much lessened and the residual blood materially reduced. (7) Intravascular pressure is decreased in the vessels distal to the occlusion.

Where one or more arteries are partially or completely occluded there necessarily occurs a marked disturbance in the circulatory equilibrium since blood is more readily carried away by the veins than it is supplied by the arteries. This increased capillary bed per unit volume of blood results in a marked decrease in intravascular pressure distal to the occlusion.

A certain minimum intravascular pressure must be maintained in the capillary area to prevent the permanent collapse of large capillary areas as well as to insure sufficient interchange of certain substances between the blood and the tissue cells.

Bier (1) has recently contributed a very interesting series of articles dealing with cell nutrition by venous and arterial blood. He states that one is led to believe that for tissue needs arterial blood is absolutely necessary and that venous blood acts detrimentally. If one has in mind the energetic metabolism connected with the function of organs or activity of muscles there can be little doubt of the need for an accelerated stream of arterial blood since the oxidation of organic substances is here the essential source of energy. Where the tissue needs are those required in preserving existing tissues, compensation for lost tissue ingredients, or in newgrowths, the energy expended is so small per unit of time and the oxygen necessary to restore the chemical compounds so small that the most carbonated venous blood will fulfill the need. He concludes that one is better off with sufficient venous blood than with an insufficient amount of arterial blood. He also calls attention to the rarity of gangrene of the diabetic or senile type occurring in limbs with varicosities.

The ability of tissue to secure the proper amount of blood for its needs independent of the central nervous system or blood pressure, Bier calls, "das Blutgefuehl," or blood sentiment.

In 1923 Brooks and Martin undertook a series of experiments to establish a firm physiological basis for the simultaneous ligation of artery and vein. Their work consisted of a series of three experiments: (1) Experiments in which the effects on the temperature of the tissue distal to the ligature was studied; (2) experiments in which the blood pressure distal to the ligature was measured; (3) experiments to test the comparative frequencies of gangrene from simultaneous ligature of artery and vein, and ligature of the artery alone.

In their first series they found that ligation of the main artery lowered the temperature of the tissues and that simultaneous ligation of the vein still further lowered the temperature. In their second series it was demonstrated that intravascular pressure in both the arteries and veins of an extremity was decreased by ligature of the artery alone. If the artery was ligated and the intravascular pressure in both arteries and veins became constant at a level lower than normal, then obstruction of the vein resulted in a rise in intravascular pressure in both arteries and veins distal to the ligature. In their third series gangrene developed in 71.5 per cent of the animals in which the main artery was ligated. In animals where both artery and vein were ligated only 33.3 per cent developed gangrene.

They evidently do not believe as do Makins, Bier, and Horsley (5) that gangrene is less frequent after simultaneous ligation of the vein because such ligation results in a retention of blood in the tissues for a longer period. In their opinion, tissues require circulation of fluids and not stagnation to promote the interchange of substances between the blood and the tissue cells. They also point out that the simultaneous occlusion of the vein has been thought to bring about a wider distribution of blood. As a result of their experiments they leave one in doubt on this point since their experiments in which the temperature of the tissues was used as a criterion seems to contradict this theory.

Krough's (6) work on capillaries has thrown light upon some questions which confront those interested in this work. One very important observation seems to bear upon the rhythmical capillary contractions. It was found that under normal conditions only part of the capillaries of a given area are open at one time and only under the stress of markedly increased tissue activity are all the capillaries open and even then there occur rhythmical contractions. Krough has also pointed out that capillary interchange of substances between blood and tissue cells is one of diffusion through a membrane rather than selective permeability, and that variations in capillary pressure have much to do with the rate of interchange between blood and tissue cells.

With the foregoing points set forth I believe we are safe in summarizing the known facts and assuming that our work along these lines will meet success or failure as we adhere to correct principles.

Simultaneous vein ligation must be so selected that it will serve only to restore circulatory equilibrium and must not result in too great a damming back of blood, lest ill effects of passive congestion outweigh the beneficial effects of increased capillary pressure. Here again Bier has pointed out that venous blood does become a source of trouble when the passive congestion exists over a long period and the venous blood becomes surcharged with tissue poisons.

Knowing the good effects which may be expected to follow vein ligation, one must also bear in mind that there is a certain lethal limit in the tidal flow of blood to an extremity or tissue.

The clinical application of the foregoing principles may be illustrated best by reviewing the results in some cases in which elective vein ligation has been done.

ARTERIOVENOUS ANEURISM

It was this particular group of cases that first attracted attention to the value of accompanying vein ligation. Callander (3) in his exhaustive study of arteriovenous fistula reported 27 cases treated by quadruple ligation with 21 cures or 77.7 per cent; 2 deaths or 7.4 per cent, and four instances of gangrene, or 14.8 per cent. These cases showed much better results than those treated by any other method tried.

I have had 8 cases[1] of arteriovenous

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[1] I have since had another arteriovenous aneurism of the femoral artery treated by quadruple ligation and obliteration—endo-aneurismorrhaphy—with excellent result.

aneurism in all of which a quadruple ligation has been done with 7 cures or 87.5 per cent; one death, or 12.5 per cent. The death occurred in a boy about 11 years of age who entered the hospital with an infected gunshot wound of the thigh. Following quadruple ligation, the severity of the infection necessitated amputation to try to save his life. Following the amputation infection spread to the buttocks and the patient died of sepsis some 2 weeks after admission. In 6 of the above cases the aneurism was femoral, in one axillary, and in one radial.

La Roque (7) has reported several cases of femoral arteriovenous aneurism treated by quadruple ligation with excellent results.

From the reported cases there can be little doubt of the efficacy of simultaneous vein ligation in arteriovenous aneurisms.

PERIPHERAL ANEURISMS (NOT ARTERIOVENOUS)

In a previous article (10) I have referred to the use of vein ligation in false aneurisms and arterial hæmatomata.

In aneurisms of the extremities I have resorted to simultaneous vein ligation in 8 cases with cures in 6 cases; gangrene in one case; and one death. In this group there were four of the popliteal artery, one axillary, and three femoral. Three cases were not subjected to vein ligation. This group was made up of one femoral, one ulnar, and one axillary aneurism.

The results in the popliteal aneurisms I believe are worthy of comment. Three patients had simultaneous vein ligation and their courses were very satisfactory, with complete functional restoration of the extremity. The one unsuccessful case was in a debilitated man 68 years of age. Gangrene followed proximal and distal ligation of the artery, and death occurred as a result of a complicating pneumonia.

THREATENED GANGRENE

Cases of threatened gangrene in which there had been no response to medical treatment were selected. We undertook some of these cases with considerable reluctance, because we doubted whether the arterial blood supply was sufficient to warrant any operative procedure. These operations, six in number, were done under local anæsthesia. In one the condition occurred in the upper extremity, in the others in the lower extremity.

In all the cases there occurred a noticeable decrease in pain and paræsthesias following the main vein ligation. The limb usually appeared to have a better color and the veins became more prominent. I have been able to follow several of the cases after discharge from the hospital. One patient is still in good condition and has had no return of pain in the extremity and shows no signs of impending gangrene at present. Of the others many seem to be returning to their pre-operative condition. Those arteriosclerotic affairs which are rapidly progressing to gangrene can be very little, if any, benefited. The milder cases unquestionably show considerable improvement for a time, and some seem permanently benefited.

ENDARTERITIS OBLITERANS AND RAYNAUD'S DISEASE

After a rather liberal number of failures to produce any appreciable change in endarteritis obliterans cases by the peri-arterial sympathectomy of Leriche, we conceived the idea of combining main vein ligation with sympathectomy. In most cases the feet became warmer, the cyanosis less marked, and the pain was often relieved. The superficial veins became prominent and gangrene seemed likely to be prevented. The results were transient and in a short time the cases progressed as did those not treated.

One case presented an unusual picture about 6 months following vein ligation. There was a marked dilatation of the superficial veins which became even more marked following a series of localized phlebitis attacks in these dilated superficial veins.

The failure to produce any permanent improvement in these cases is due, I believe, to the progressively diminishing tidal flow of blood to the tissues which is not improved by sympathectomy, and is little influenced by vein ligation.

COMMON CAROTID LIGATION

Much discussion has arisen from time to time over cases of cerebral changes following sudden occlusion of the common carotid artery. If, as many believe, its effects result from extending thrombus formation from the site of ligature toward the cerebrum, or embolism, then simultaneous vein ligation has nothing to recommend it. If it be due to anæmia, then a simultaneous ligation of the internal jugular on the same side should lessen the cerebral complications in these cases. Makins and Ceci report cases treated in this manner with good results.

CONCLUSIONS

1. Simultaneous vein ligation has a definite place in blood-vessel surgery.

2. One should be familiar with the principles governing the use of vein ligation before doing it, as harm may result if it is used in cases in which it is not indicated.

3. It probably has its greatest field of usefulness in cases in which the main artery is suddenly occluded.

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Suture of Wound of the Heart

LIGATING THE INTERVENTRICULAR BRANCH OF THE LEFT CORONARY ARTERY AND VEIN

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SUTURE OF WOUND OF THE HEART

LIGATING THE INTERVENTRICULAR BRANCH OF THE LEFT CORONARY ARTERY AND VEIN *

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The case here reported concerns a punctured wound of the heart penetrating the upper portion of the middle third of the right ventricle anteriorly, near the septum, and accompanied by hemopericardium. The cardiac wound was not complicated by any injury to the pleura or lung, and, in the closure of the heart wound, ligation of the interventricular branch of the left coronary artery and vein became necessary.

REPORT OF CASE

History.—J. S., a white man, aged 44, a machinist, admitted to the detention ward of the Cook County Hospital, Aug. 3, 1920, came voluntarily, complaining of being very much depressed over the recent death of his mother. After the usual examination, a tentative diagnosis of simple depression was made, and the patient remained for further observation. The patient had a good physique and was well nourished. The heart examination, in particular, did not reveal any abnormality. The blood pressure was: systolic, 120 mm. of mercury; diastolic, 80 mm.

The day following the examination, August 4, the patient inflicted on himself a stab wound, using for this purpose a 16 penny casing nail or wire nail 3½ inches long and about a 12 gage size (Fig. 1). He must have grasped the nail in his right hand and made several attempts at stabbing himself in the left breast, for there were numerous superficial punctures of the left part of the thorax somewhat below the precordial region. Not satisfied with this, he changed the nail to his left hand, pressed the point to his left breast and. using his right fist as a hammer, drove the nail up to its head into the chest. The resulting skin wound was located 1 inch inside the nipple line in the fourth interspace (Fig. 2, 1)

At about 1:45 p. m. on the same day, the patient was seen to stagger and sink to the floor. The attending intern at once noticed the bleeding from the left chest and extracted the nail with artery forceps. Blood exuded freely during and after this manipulation. The radial pulse being hardly perceptible, stimulation with camphor in oil, and strychnin was administered, and the patient was immediately transferred to the surgical service.

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* Read before the Chicago Surgical Society, May 6, 1921.

Examination.—The patient was conscious, his face had an expression of anguish, the skin, in general, was pale, cold and clammy, and the lips, the tip of the nose and the finger nails were slightly cyanotic.

The radial pulse was small, rapid and irregular, periodically becoming imperceptible. Respirations were shallow, and there was a slight increase in the extent of the cardiac dulness. Auscultation revealed diminished and irregular heart tones. Fluoroscopy demonstrated a moderate increase of the cardiac shadow. An elaborate examination with the patient in the sitting posture was not possible because of his condition. The freely bleeding stab wound in the precordial region, together with the symptoms already enumerated, pointed toward a cardiac injury, and, under this tentative diagnosis, the patient was at once removed to the operating room where preparation was made for the indicated surgical intervention.

Operation and Result.—The operation started at about 2:30 p. m., local anesthesia (procain, 1 per cent. solution) being employed. An area large enough for rib resection was blocked off, the fact being kept in mind that a diagnosis of the exact location of the wound in the heart is impossible until after exploration. Herein lies one great difficulty in heart surgery. Thus, the mode of approach being indefinite, I proceeded to place the incision so that more than one rib could be resected, or, if necessary, a flap operation could be employed.

An incision 12 cm. long was made from the center of the sternum to the left, over the fifth rib and curving slightly upward toward the axilla (Fig. 2, 1). The skin edges were undermined above and below, the incision then being carried down through the pectoralis major muscle and the periosteum of the fifth rib (Fig. 2, 2).

The periosteum was peeled off, and 5 cm. of the fifth rib with a portion of its cartilage was resected (Fig. 2, 3), care being taken not to open the pleura, because herein lies the ultimate danger of infection, although many observations show that the pleura is nearly always opened during operative manipulation, if opening does not already exist.

The muscles were then pushed up and out with a periosteal elevator toward the fourth rib, as well as downward toward the sixth rib, and retracted.

Then the cellular tissue along the sternal border was grasped, incised carefully from the lower border of the fourth rib downward and pushed outward with the internal mammary artery, the pleura stripping with ease from the pericardium.

All the tissues in the field so far were infiltrated with blood, even to the dense pericardium. The blood was seen escaping freely from the stab wound in the pericardial sac, a leakage which, I believe, prevented a marked heart blockage from hemopericardium, a condition which probably would have resulted in death before an operation could have been instituted.

The pericardium was grasped with forceps, lifted up and an oblique incision made 5 cm. long downward and outward, starting at the border of the sternum just below the lower border of the fourth cartilaginous attachment (Fig. 3, 4).

Retractors were then placed in this incision, one below and two above; too great a pull on the outer retractor caused more irregularity in the heart action because of the dragging on the great vessels at the base.

The pericardial sac was filled with liquid blood, and there was also present a large clot, which eased itself out of the retracted opening in the pericardial sac as a result of the pressure within the sac increased by the heart action. The clot was about the size and shape of the palm of the hand with the fingers, and had the appearance of whipped up fibrin.

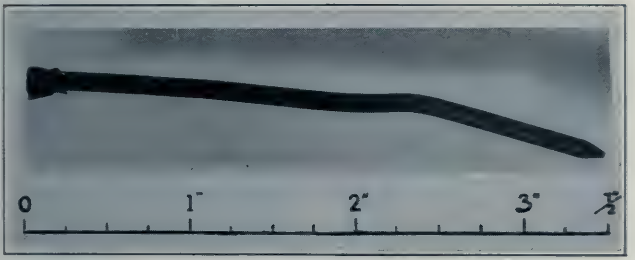

Fig. 1.—The nail with which the wound was inflicted.

The heart presented a wound about 5 mm. in diameter, located in the upper portion of the middle third of the right ventricle anteriorly, about 3 mm. to the left of the interventricular branch of the left coronary artery and vein; these vessels were seen to fill and empty with each heart beat.

The cardiac wound extended through the right border of the septum of the ventricles into the right ventricle. From this wound was seen coming with each ventricular contraction a jet of dark blood, which struck against the chest wall at the under surface of the fourth rib.

The wound of the heart was closed with interrupted silk sutures carried on a full curved needle. A straight needle was not used because it cannot follow the movements of the heart and will tear the myocardium. Digital pressure was made over the wound to keep the blood from befogging the field. The first, or center, stitch went into the thick septum of the left side and out through the wound, then across into the wound and through the thin, flabby wall of the right ventricle, going under the interventricular branch of the left coronary artery and vein, and coming out just to the right of them, avoiding the endocardium (Fig. 3, 5). The stitch was tied and the knot tightened when the muscle was in repose, this suture being left long, to be used as a guide and tractor for the placing of the other two sutures. It was found that almost all the bleeding had stopped except for some oozing above and below this stitch, so with one sweep of the needle going under the vessels mentioned above, a stitch was placed above and below the first one, stopping all bleeding (Fig. 3, 6).

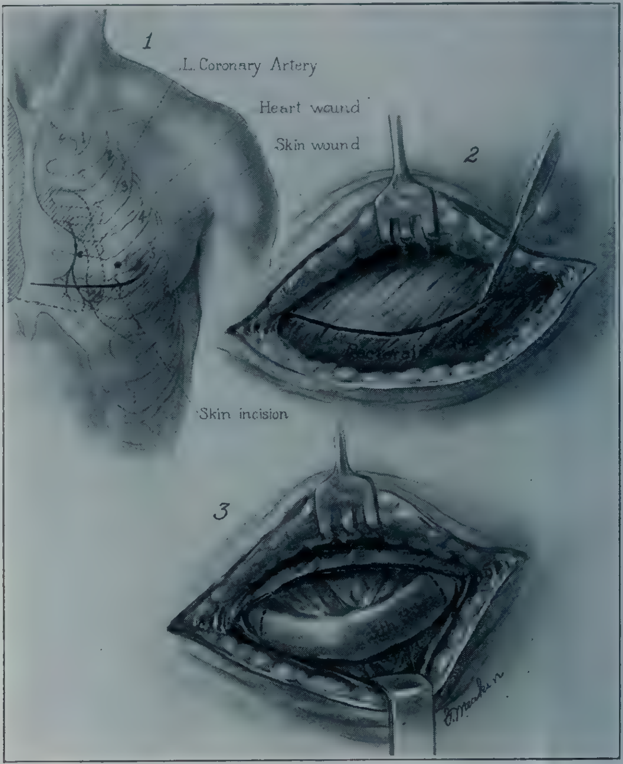

Fig. 2.—Operative procedures: 1, location of wounds and incision; 2, incision extending through pectoralis major muscle; 3, resection of the fifth rib.

Then, with a running silk stitch similar to a Lembert suture, an attempt was made to reinforce the first suture line as well as to cover them over in order to prevent adhesions;

it was noted that there was a tendency for these sutures to tear out in places because of the tension and the muscular action of the heart wall (Fig. 3, 7).

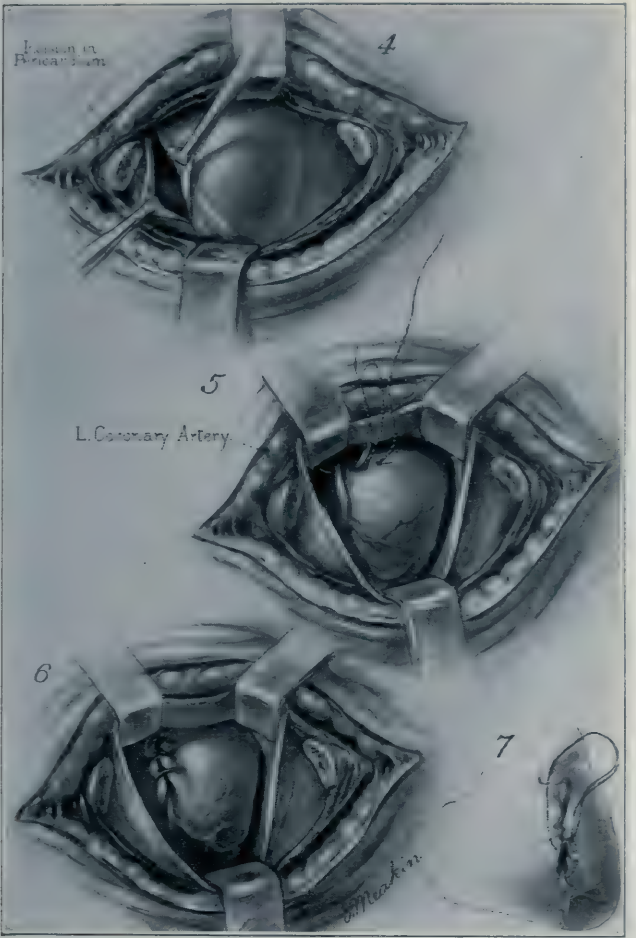

Fig. 3.—Operative procedures: 4, incision in pericardium; 5, the first or center stitch, coming out to the right of the coronary artery; 6, addition of a stitch placed above and another below the first one to stop bleeding; 7, reinforcing of the first suture line with a running silk stitch.

Some of the sutures were placed during special time in the cardiac cycle; that is, during ventricular contraction when the thin, flabby wall of the right ventricle is firmer, and when it is not so easy to include the endocardium in the stitch.

The remaining stitches were inserted at any time, while the mobility of the heart was steadied with the left index finger on the apex.

The blood remaining in the pericardial sac was mopped out with wet laparotomy sponges, and the sac closed with interrupted catgut sutures.

A gutta percha drain was inserted down to the pericardium, the muscles were brought together with catgut, leaving out the portion of resected rib, and the skin was closed with black silk. On two occasions during the operation, it became necessary to give the patient camphor in oil hypodermically because of the extremely poor pulse.

Since the patient was not suffering from hemorrhage, there was no need of intravenous salt solution or of blood transfusion.

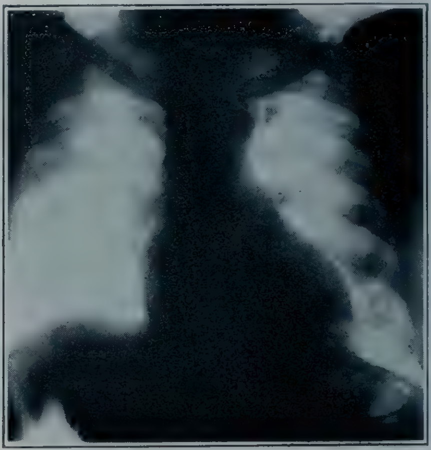

Fig. 4.—Cardiac shadow: the similarity of configuration to that of an aortic regurgitation may be noted.

The drain was removed after forty-eight hours, and there were no postoperative complications. The wound healed kindly, and the patient was out of bed, August 17, thirteen days after the operation. A roentgenogram of the chest at this time showed the heart to be slightly increased in size. The configuration of the cardiac shadow was similar to that of an aortic regurgitation (Fig. 4).

The radial pulse chart showed irregularity in the pulse rate, especially during the first three days after operation. The patient, on the second, third and fourth days after operation had intermittent periods of labored respirations, and, for the first nine days after operation he was restless, a condition which was partly controlled by morphin.

Further Examinations.—Examination of the heart following the operation revealed irregular action, probably due to premature contractions.

When the patient was discharged from the hospital, August 27, the heart examination revealed a slight enlargement but no murmurs. September 1, four days after leaving the hospital, the patient resumed his former occupation.

The patient was sent to Dr. Fred Smith for a series of electrocardiographic tracings, requesting findings and diagnosis. At the time when the first tracing was made, August 23, Dr. Smith was not cognizant of the fact that a branch of the left coronary artery and vein had been ligated during the operation.

The first electrocardiogram (Fig. 5) was made, August 23, nineteen days after the operation, and Dr. Smith reported that the striking feature of the electrocardiogram was the negative T deflection in the three deviations, and that these findings suggested that one of the branches of the left coronary artery had been ligated in repairing the cardiac wound.

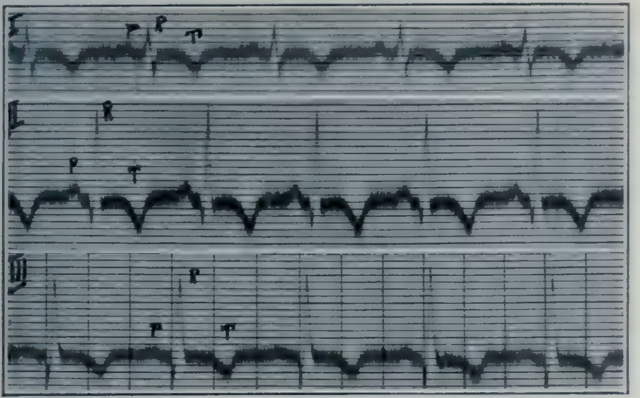

Fig. 5.—First electrocardiogram, made nineteen days after operation.

The second electrocardiogram (Fig. 6) was made, September 9, thirty-six days after the operation. The report was that the T wave had become less negative, and that this change in the electrocardiogram was very similar to that in the dog following the experimental ligation of branches of the left coronary artery.

The third electrocardiogram (Fig. 7) was made, October 2, fifty-nine days after the operation. The report was that the electrocardiogram was similar to the one made at the former visit (Fig. 6).

The fourth electrocardiogram (Fig. 8) was made, April 18, 1921, 257 days, or eight and one-half months, after the operation. Dr. Smith reported that the T wave had changed to the positive phase, and that these findings still conformed to the electrocardiographic changes in the dog following the experimental ligation of branches of the left coronary artery. Examination of the heart, made by Dr. Smith on the same day, revealed only a slight enlargement, no clinical evidence of any sequelae, such as adhesions of the pericardium, asystole, palpitation or dyspnea, conditions that may result from pleuropericardial adhesions.

COMMENT

After reviewing the available literature, I find that differences in opinion still exist as to the origin and significance of the T wave in its various phases, but the character and change of the T deflection in the electrocardiograms of this man are similar to those that Smith[1] produced experimentally in the dog by means of the ligation of branches of the left coronary artery. They also resemble the electrocardiographic tracings in the case diagnosed and reported by Herrick,[2] in which thrombosis of the left coronary artery was verified later at necropsy.

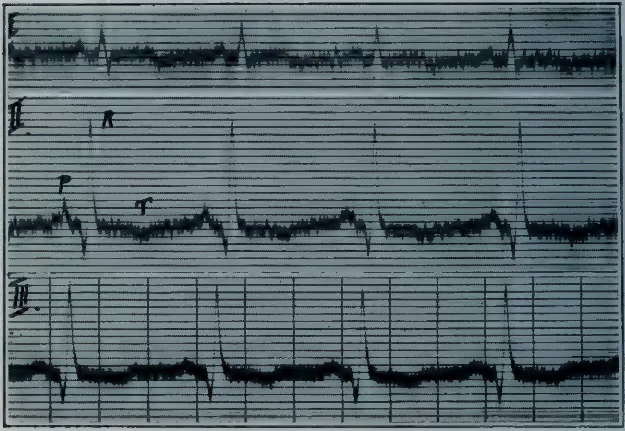

Fig. 6.—Second electrocardiogram, made thirty-six days after operation.

As this is only the report of one case, there is need for further confirmation, and I present these facts for consideration.

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[1] Smith, F. M.: Ligation of Coronary Arteries, Arch. Int. Med. **22:** 8 (July) 1918; Further Observations on T-Wave of Electrocardiogram of the Dog Following Ligation of Coronary Arteries, ibid. **25:** 673 (June) 1920.

[2] Herrick, J. B.: Thrombosis of the Coronary Arteries, J. A. M. A. **72:** 387 (Feb. 8) 1919.

The appearance of the scars in the case reported here, when the patient was discharged from the hospital, is shown in Figure 9. The operative scar was inked.

Surgery of the heart is a recent conquest, the first cardiorrhaphy having been performed in the year 1896 by Farina of Rome. In 1901, of the twenty-six instances tabulated, three operations were performed in America. In 1909, Vaughan[3] gathered 150 cases in which operations had been performed for wounds of the heart with a total of ninety-eight deaths, representing a mortality rate of 65 per cent.; of the 150 operations tabulated, fourteen were performed in America. In 1919, Costantini[4] gathered 281 cases in which operations for wounds of the heart had been performed, with a total of 140 deaths, or a mortality of about 50 per cent.

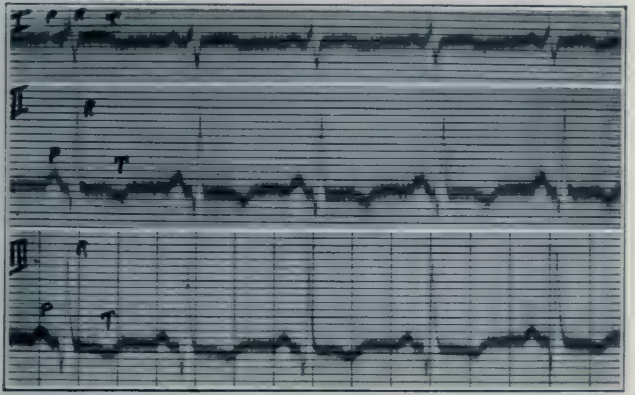

Fig. 7.—Third electrocardiogram, made fifty-nine days after operation.

Operations for all injuries of the heart should be performed immediately, according to Holmes and Fisher, who in 1881 reported, prior to the days of cardiorrhaphy, a mortality of 85 per cent. The possibility of a spontaneous repair of heart wounds is evidenced daily in the laboratory in taking blood from the guinea-pigs for the complement used in the Wassermann test when a large (18 gage) needle is thrust into its small heart. It was reported that, one of these animals, its heart having been punctured a great many times during the previous eighteen months, died recently as a result of pericardial hemorrhage following the last puncture, that examination of the heart revealed no gross changes, and that, microscopically, the muscle showed no scar tissue or recent inflammatory tissue.

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[3] Vaughan, G. T.: Suture of Wounds of the Heart, J. A. M. A. **52**: 429 (Feb. 6) 1909.

[4] Costantini, Henri: Surgical Treatment of Heart Wounds, J. de Chir. **16**: 383, 1920.

The diagnosis of heart injury is difficult, but it can be made if one examines the wound carefully and knows the exact interpretation of each symptom and sign.

The importance of the following considerations is well illustrated by the case just cited.

When there is loss of consciousness, it may have been caused by cerebral anemia resulting from hemorrhage or ventricular blockage due to hemopericardium. A skin wound in the precordial region with the presence of copious hemorrhage is very significant of cardiac injury; although, in certain cases, the wound may be quite remote from this location, and a heart wound may be present.

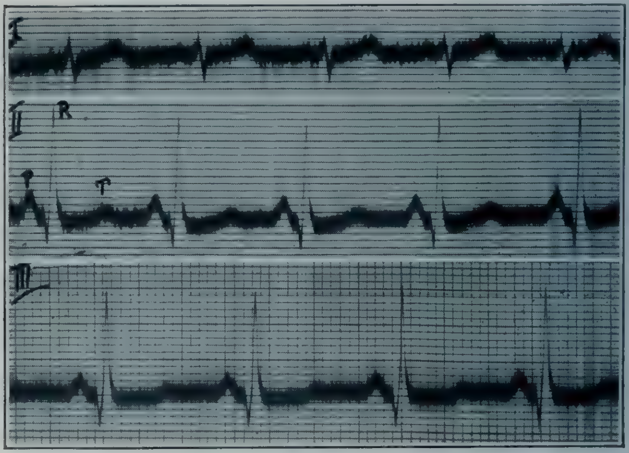

Fig. 8.—Fourth electrocardiogram, made 257 days after operation.

The expression of anguish and agitation is caused by cardiac blockage from the hemopericardium or by cerebral anemia. The pale, cold and clammy skin is the result of shock. Cyanosis of the lips, tip of the nose and finger nails, accompanied by pallor, is very significant of hemopericardium, a condition which early manifests itself by interference with the venous return, and finally results in blockage of the heart.

The pulse in this case was small, rapid and irregular; but one must bear in mind that in certain dry wounds the pulse may remain good, and that in these dry wounds intermediate hemorrhage may occur, explaining the appearance of a hemopericardium with blockage of the heart days after the injury.

Dyspnea and superficial respiration result from anemia or hemothorax, and a pneumothorax when these conditions are present.

The increase in cardiac dulness with diminished heart tones is very important, indicating the presence of a hemopericardium. The fact that murmurs are present is of little value.

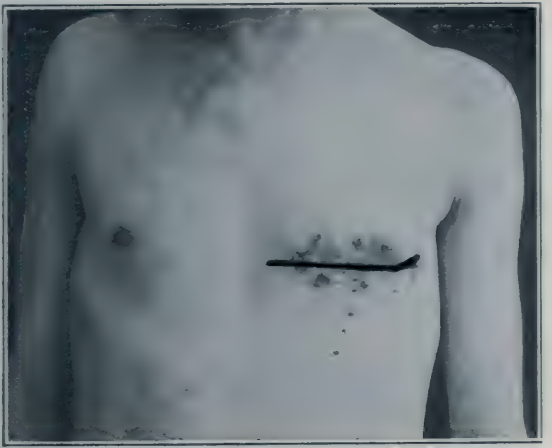

Fig. 9.—Appearance of scars when the patient was discharged; the operative scar was inked; the small scars resulted from puncture wounds made by the patient.

Fluoroscopic examination when a projectile is present reveals its approximate position and depth. A very important sign is the immobility of the cardiopericardial shadow, which reveals the existence of a hemopericardium, but which is difficult to demonstrate if a hemothorax coexists. Absence of movement of the diaphragm when that is injured, as well as the presence of blood in the thoracic cavity, may point to an injury of the heart.

The course of surgical procedure in heart injuries is, first, to establish the diagnosis of the cardiac injury, and, secondly, to ascertain the exact location of the heart wound, controlling hemorrhage by digital pressure while the necessary further exposure is carried out. Right sided injuries should be approached from the right, although they can be handled from the left if a large flap is raised, including cartilages with portions of their ribs, the third, fourth and fifth ribs, and also a transverse section of the sternum. The pedicle should be placed to the outer side, where there is less danger of injury to the pleura; but if it is placed internally, the triangularis sterni muscle must be cut to raise the flap, and great care must be used not to cut or tear the pleura. Flap operations are necessary in repairing wounds of the auricles. Types of flaps are shown in Figure 10, in which, in the center of the pedicle, is seen a transverse incision for the purpose of dividing the fourth rib. Ventricular wounds are easily sutured by the resection of one or two ribs. If the heart is bleeding profusely, the opening in the chest is too small, and there is no time to lose, since it is too late to raise a flap, a larger portion of rib out toward the axilla is resected and, by means of a self-retaining retractor or a rib spreader, the work is done quickly through the pleura.

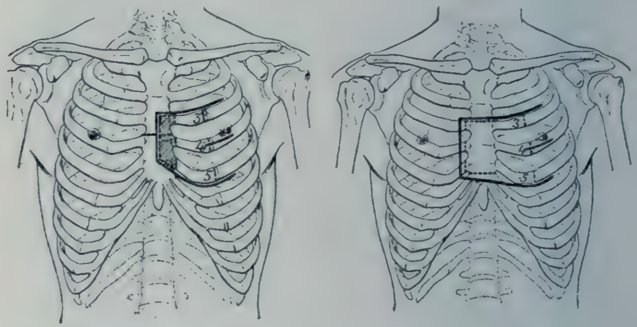

Fig. 10.—Types of flaps: in center of pedicle, a transverse incision for the purpose of dividing the fourth rib; after Costantini.

According to Rehn,[5] bullet wounds of the heart giving opportunity for first aid comprise only a limited chapter in war surgery. The greater number of men so wounded die on the battlefields, as only a small percentage may be transported; for such patients, the bomb-proof station guarantees the best opportunity for proper surgical attention.

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[5] Rehn, Edward: Zur Chirurgie des Herzbeutels, des Herzens und grossen Gefassstammes im Felde, Beitr. z. klin. Chir. **106**: 634, 1917.

In the later operations for retained projectiles and wounds entering from the back, Matas[6] urges the Duval-Barasty operation, or the median thoracophrenic laparotomy (Fig. 11) for the complete exposure of the heart and vessels at the base. Three cases of operations performed in this manner were reported in 1918. The incision is made in the median line extending down below the xiphoid cartilage, cutting the sternum in the midline, and also transversely at the level of the third cartilage; then the diaphragm is incised from the front backward to the triangular ligament.

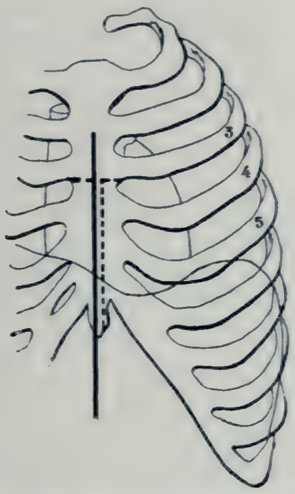

Fig. 11.—Site of median thoracophrenic laparotomy; after Costantini.

Duval, up to 1918, reported a total of sixty-two cases of war projectiles in the heart; thirty-nine were cases of parietal or mural wounds, and sixteen of these patients were operated on, with a result of two deaths; twenty-three patients were not operated on, and no deaths were reported.

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[6] Matas, Rudolph: Routes of Access to the Heart: Lessons Gathered from the Experiences of the World War, M. Rec. **99**: 595 (April 9) 1921.

Another interesting series was reported of twenty-three cases of projectiles retained in the heart cavities; ten of these patients were operated on, with three deaths occurring; thirteen were not operated on, with a result of only one death.

These statistics, as Matas has stated, "favor the non-operative treatment, but indications cannot be formulated on statistics, only on the individual prognosis as to the condition of the patient, degree and duration of disability, and when the life of the patient is threatened by the presence of the projectile."

Occasionally, in the field of operation, one may find the remains of a persistent thymus.

Knife wounds are usually penetrating and single. Bullet wounds are apt to be perforating or double, and this is especially true if the wound is on one side of the chest, and the fluoroscope shows the projectile on the other.

Prognosis in Cases in Which Operation Was Performed

Cases	Deaths Number	Mortality Per Cent.
221 ventricular wounds	118	53
36 auricular wounds	14	38
119 left ventricular wounds	65	55
102 right ventricular wounds	53	52
23 wounds of coronary arteries	10	44
213 knife injuries	111	52
74 projectile injuries	35	47
13 wounds of the abdomen associated	10	99
27 wounds of the lung	19	70
128 hemopericardium	49	38
48 hemothorax	27	57
62 hemothorax and hemopericardium	43	69

Digital pressure is the procedure of choice in controlling bleeding from the heart. Such methods as the pinching of the vena cava at the base with the thumb and index finger, and pinching the base of the ventricle, have their drawbacks because a dangerous anemia is created; grasping of the edges of the wound with Kocher forceps may cause further tearing in the muscle.

It is impossible to avoid the endocardium in suturing wounds of the auricles because of their thin walls. For this reason, Villar proposed ligature *en masse,* after grasping the edges of the wound with artery forceps. Searching for foreign bodies is to be avoided, as this organ takes care of projectiles admirably. The hemorrhage is to be checked at once, but if the projectile is under the finger, the myocardium should be incised and the projectile extracted.

Wounds of the trunks of the coronary arteries are fatal, and death results before they are seen by the surgeon. When branches of the coronary arteries are wounded, these vessels require ligation at both ends as Dumenici first recommended, because they may bleed later and a resulting hemopericardium may be fatal.

The pericardium can be drained; but, if there is a pulmonary wound, it must be cared for and the wound of the pleura closed if infection is to be avoided.

If manipulation of the heart should cause it to stop during the operation, simple, gentle massage is employed. This, however, is of no avail when the arrest is caused by exhaustion of the heart muscle.

Costantini states that up to the year 1919, the average mortality was about 50 per cent., hemorrhage being the greatest cause and infection next.

The heart takes care of blockage better than it does of open exposure.

Postoperative complications, such as intermediate hemorrhage, may result when catgut is used in suturing the cardiac wound, because it has a tendency to soften and give way. Embolism may occur from separated portions of the endocardium. It is diagnosed by characteristic symptoms observed immediately after operation.

Infection after hemorrhage is the predominant cause of death; about 50 per cent. of all the patients surviving the first twenty-four hours developed infections. When it occurs, it usually involves the pleuropericardial surfaces. Instances have been reported in which recovery followed the drainage of a purulent pleurisy.

I would refer those interested in the surgery of the heart to Costantini's paper,[4] from which I have drawn freely.

It is a great pleasure to acknowledge my indebtedness to Drs. Fred Smith and O. T. Schultz.

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Ventriculography, Its Place in Brain Surgery

BY

GEORGE L. DAVENPORT, M. D.

CHICAGO

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VENTRICULOGRAPHY*
ITS PLACE IN BRAIN SURGERY

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CHICAGO

Ventriculography or cerebral pneumography is the replacement of the cerebrospinal fluid with air, in order to make the outlines of the ventricles and passage ways of this fluid distinctly visible on the Roentgen plate. To W. E. Dandy[1] is not only due the credit for the introduction of this procedure, but to a large extent, the clinical application thereof.

We have applied this procedure in 28 instances of intracranial lesions and feel there has been added to our armamentarium of already known methods of diagnosis another method of precision.

In the ventricular injection of air we enter the ventricle through a burr opening or the open fontanelle ,in the infant's skull, at Kocher's point of election on the right side, with the patient lying prone, neck flexed and looking towards the left, puncturing through the frontal lobe. The needle point enters the anterior horn or at its junction with the body of the lateral ventricle.

A record syringe with a two way petcock is then joined to the needle after removing the obturator, and the ventricular fluid is removed gradually, 5, 10 or 15 c.c. at a time and replacing same by air before the withdrawal of more fluid is begun. This is repeated until no more fluid can be withdrawn, when the needle is removed and the scalp sutured.

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*Read before the Illinois State Medical Society, May 16, 1923, Surgical Section, at Decatur, Illinois.

In order to secure good pictures it is necessary to at least empty the contents of one lateral ventricle or preferably more. Following the technique described above we have always succeeded in getting a satisfactory evacuation.

The procedure is carried out under local anesthesia and while the air is being injected the patient is watched continually and asked from time to time if he feels comfortable, because when the replacement of the fluid by air is done too rapidly there is occasionally noted a dizzy or faint feeling. After the injection of air has been completed the head is kept slightly higher than the body level by placing a pillow under the head.

In two instances of ventricular injection of air we found the emptying of the ventricles was a "compulsory gradual emptying." These were cases of extensive gliomas involving the occipital and parietal lobes; there was interference with the ready flow of fluid from one ventricle into the one on the side that was being emptied due to a partial closure of the foramen of Monro as a result of displacement by the tumor or edema about this opening. Thus if this ventricle which was entered was very much smaller, one obtained a very small amount of fluid and due to the partial obstruction, drainage from the other ventricle was slow and emptying it took a considerable time.

The total quantity of fluid removed will help in gauging the size of the ventricles. The simple use of the diagnostic ventricular puncture and the obtaining of a large quantity of fluid which indicates dilated ventricles, may favor the diagnosis of a posterior lesion. In one instance we had a tumor of the frontal lobe displacing the ventricle on the tumor side, yet in this case the ventricles were dilated, furnishing over 60 c.c. of fluid. There was present either enough subarachnoid obstruction due to increased intracranial pressure preventing absorption of the fluid or there was a double lesion present, a frontal tumor with a lesion of the posterior fossa.

Routine Wassermann tests and microscopical examinations are carried out on all ventricular fluids removed, thus excluding the employment of spinal puncture, which is dangerous in cases of brain tumor especially if located in the posterior fossa.

The x-ray pictures should be taken soon after the air injection has been completed before a great deal of the air becomes absorbed or dispersed. This is imperative when only a small quantity of air could be introduced.

Four views are usually taken with the vertical ray, two laterals, an antero-posterior and a postero-anterior. In the lateral views the distance from the target to the plate is 66 cm., in the antero-posterior and postero-anterior the distance from the target to the plate is 61 c.m., these distances are maintained in all our work so as to give us a relative exactness as to the size of the ventricles in each case.

In the lateral views with the sagittal plane parallel to the plate, right side of head down, the ventriculogram reveals a picture of the left lateral ventricle and vice versa. In the antero-posterior view the frontal region is nearest the target with the sagittal plane at right angles to the plate, ventriculograms reveal a picture of the anterior horns. In the postero-anterior view the occiput is nearest the target and the sagittal plane at right angles to the plate, the ventriculograms reveal a picture of the posterior and descending horns.

All plates should be carefully marked and the time of exposure is the same as for any head picture bearing in mind the fact that the skull of an infant is penetrated easier and the time of the exposure is much shorter than for the adult skull.

Townee[2] recommends the taking of four additional views of the fluid levels, using the horizontal ray. Two lateral views, one with the occiput up and another with tne frontal region up, also two antero-posterior views first with the right side up and then the left. These additional pneumograms add information to our composite in arriving at a definite interpretation of the findings.

The intraspinous injection of air recommended by Dandy[3] in addition to revealing all intracranial passages, may be of valuable service in early hypophyseal lesions. The technique is quite similar to the intraventricular injection of air always maintaining the head of the table elevated 15° until after the pictures are taken. This procedure is of special value in localization of the obstruction in the communicating types of hydrocephalus, but is contraindicated in cases of brain tumor located in the posterior fossa.

One should never arrive at a diagnosis from the x-ray findings alone, which point holds good for all laboratory methods of diagnosis. A correct diagnosis and localization of the intra-cranial lesions is based on a careful history, thorough examination and observation of the patient and last the interpretation of the x-ray findings following the ventricular or intraspinal injection of air.

The interpretation of the x-ray findings requires a complete knowledge of the technique of the ventricular or intraspinous injection of air, position of the head, total quantity and difficulty with which the fluid was removed. The x-ray findings include such displacements of the ventricles which are brought about by tumors and cysts when allowance is also made for edema near a tumor or in remote areas; in cases of hydrocephalus a knowledge of the various areas and points of obstruction and lastly a careful opposite side comparison.

Indications for cerebral pneumography are:

1. In cases where a tumor could not be localized by other means.

2. In cases operated on and no tumor found.

3. In cases in which secondary manifestations were so pronounced as to completely overshadow the early clinical symptoms which results from a general pressure phenomena, displacement or edema.

4. As a corroborative procedure when it is necessary owing to the fact that the clinical history, the examination of the patient and observation had not been conclusive enough to aid in the localization of the tumor.

5. To gain information as to the size and extent of the tumor.

6. Cases of hydrocephalus in determining the site or region of the obstruction which caused this accumulation of fluid.

7. Localization of the origin of a tumor as in the case of brain tumor existing for some time suddenly developing typical Jacksonian epilepsy which may result from either extension, pressure, hemorrhage or edema, and yet the tumor may originate in the extreme frontal region, sub-cortical or post-parietal areas. This permits of the opening of the skull directly over the tumor rather than a wide opening over the motor region often far removed from the tumor.

We are all agreed that any diagnostic-method of procedure should be made as safe as possible. Up to the present time we have utilized this method in 28 cases of intra-cranial lesions without a death that can be ascribed to the operation and only in four instances were there any untoward manifestations. In one case while the air was being injected the patient complained of dizziness, in the other three there occurred within an hour after the operation, slight pallor of the skin, dizziness, nausea and vomiting. The only treatment instituted was to keep the patient warm and the head high, when these symptoms passed off in a short time.

It is possible that serious results can occur from hemorrhage into the ventricles, by air embolism, by a sudden reduction in the intracranial pressure, or by a sudden increase of the intracranial pressure thus causing an acute increase of the latter which might cause the rupture of a weakened stretched blood vessel or the sudden disturbance of a vital center in the brain.

Operative treatment when instituted confirmed the previous pneumographic findings. Of the 28 cases of cerebral pneumographies reported eleven were subsequently operated upon with nine deaths resulting from within a few hours to seven months thereafter. Thus in this small series of cases a mortality of 89% resulted.

The operative results must not be judged only by the remote results and their mortality but also should be taken into consideration that even a temporary result saves the patient exquisite suffering and blindness.

With the introduction and careful use of this procedure it seems only fair to assume that our selection of cases and end results in brain surgery cannot help but improve.

Dr. Davenport showed several slides of cases he had operated on to substantiate the points he had made.

1. Dandy, W. E.: Ventriculography following the Injection of Air into the Cerebral Ventricles. Ann. Surg., 66:5; July, 1918.

2. Townee, E. B.: The Value of Ventriculography in Localization of Intracranial Lesions. Arch. Surg. 5:144; July, 1922.

3. Dandy, W. E.: Roentgenography of the Brain after Injection of Air into the Spinal Canal. Ann. Surg. October, 1919; p. 397.

THE ISOLATION OF THE SUBMUCOSA AS AN AID IN INTESTINAL ANASTOMOSIS

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THE ISOLATION OF THE SUBMUCOSA AS AN AID IN INTESTINAL ANASTOMOSIS[1]

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From the Department of Surgery, College of Medicine, University of Illinois

THE purpose of this paper is to show the part played by the submucosa in the development and performance of enterorrhaphy; to explain, by directing attention to its physical properties, certain measures that are now being taken, such as walling off infected areas with bowel; and to suggest further utilization of this membrane.

The existence of the submucosa as an entity has been known many years, but an appreciation of it in intestinal suturing has not been sufficiently dwelt upon, the task being left for the individual surgeon to work out for himself. This lack of clearness was due, in part, to the older histologies, such as Stricker's (1), 1872, describing the bowel wall as consisting of two tubes, (1) mucous and (2) muscular. Its location and character were mentioned but no idea was given of its appearance as isolated; it lost its identity in the mucosa. The sliding of coats, or eversion of mucous membrane at operations occurs between the submucosa and muscularis. It was formerly customary to speak of the everted portion as "mucosa," and thus the submucosa was lost sight of.

HISTORICAL

To understand the development of this appreciation of the submucosa, it is necessary to review the estimates put upon it by surgeons of the past in intestinal anastomosis.

Lembert (2), in 1826, showed that healing must be by peritoneal approximation, and described the plastic lymph which seals the joint. His stitches penetrated "as far as" the mucous membrane. Operators of that day, thinking of the eversion of the mucous membrane, and of the "two tubes" often missed the submucosa entirely. Lembert said that his stitches encysted and were not sloughed into the lumen of the bowel. The researches of Schmidt, Thompson, and Travers soon afterward, however, showed that stitches as foreign bodies were cast off to the lumen of the bowel.

Fifty years later, or after abdominal operations were becoming more frequent, Czerny (3), in 1881, wrote, "in order to prevent the escape of intestinal contents, and to place the parts in an ideal condition for repair," he caught up the mucosa and (submucosa) in another row of stitches.

Lister (4), in 1881, first described the isolation of the submucosa, and brought the first notice of it to surgery by the following description: "Catgut, as you are doubtless all aware, is prepared from the small intestine of the sheep. The gut is treated in what seems an exceedingly rude manner for so delicate a structure. It is scraped with some blunt instruments, such as the back of the knife, over a board; and by this means, as the people express it, the dirt is scraped out. That which these people call the dirt is the exquisite and complicated structure of the intestinal mucous membrane. But while the mucous membrane is scraped out from within, there is also scraped off from without the circular coat of muscular fibers. The result comes to be that the intestine is converted into a comparatively unsubstantial material consisting of two parts or bands, one more slender than the other. When the mesentery is stripped off by the butcher the peritoneal covering of gut shrinks into a narrow strip, and this, with some of the longitudinal fibers, constitutes the more slender of the two parts to which the intestine is reduced by this process of scraping. The

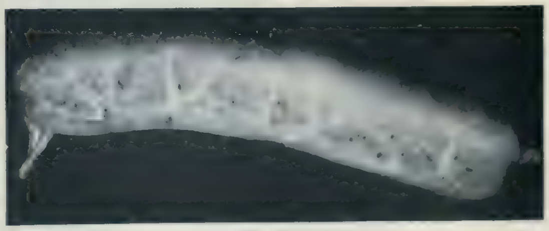

Fig. 1. Photograph of sausage casing. Observe its deviations under the blood vessels.

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[1] Read before the Chicago Surgical Society, May 4, 1923.

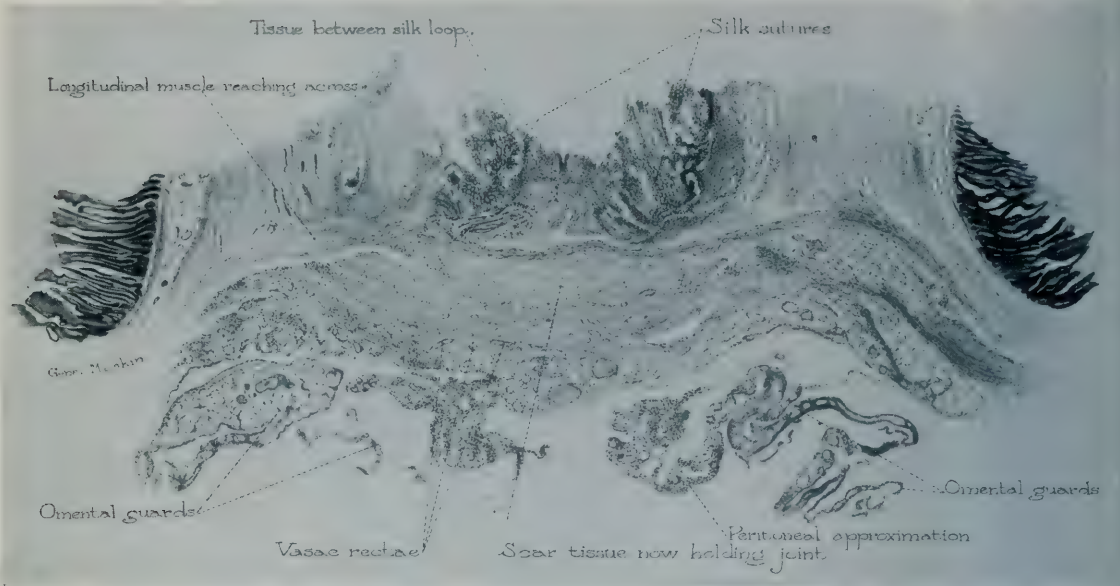

Fig. 2. Five day joint. Note loops of silk sloughing out; the reaching across of longitudinal muscle; scar tissue holding the joint at this time; remains of two vasæ rectæ which were placed side by side at the operation; and the omental guards.

other part is the essential material from which catgut is prepared, and this is neither more nor less than the submucous cellular coat of the intestine. When I first visited a catgut manufactory I was astonished to find that, after this scraping process, the intestine could be blown up still as a continuous tube, as you see can be done with this specimen, which has been treated in the manner I have described. This exquisitely delicate structure is a beautiful anatomical preparation of the submucous cellular tissue, though made in so rude a fashion. This coat of the intestine, which, in the sheep, has this extraordinary toughness, is the material out of which catgut is prepared."

Bacteriology at this time cleared up the question of external sepsis so that causes of failure could be understood.

Mall (5, 6) demonstrated in 1887 the reticulated tissue in the stratum fibrosum.

W. S. Halsted (7), in 1887, and working later with Mall, isolated the submucosa and described it as "air-tight and water-tight." Employing needles with dulled points he proved that sutures with a grasp of the serosa and muscularis only were "not to be trusted." (Exp. A, Halsted, 7.) He insisted that "each stitch should include a bit of submucosa" and stated, "I am not aware that the importance of this coat has been hitherto emphasized." Again, in 1891, he wrote, "Success depends upon an appreciation of the importance of the submucous coat of the intestine," and that it was "remarkable that surgeons could have overlooked the existence of the submucosa"; and again, "About 3 years ago I endeavored to emphasize the importance of the submucous coat in operations, but succeeded only in attracting attention to the quilt or square stitch." He feared then the entrance of the stitches into the lumen, and thought the stitches encysted, or sloughed to the serosa.

M. E. Connell (9), in 1892, "in order to reduce the number of stitches and knots" devised the continuous mattress suture.

Murphy (10), in 1892, with the button, demonstrated how quickly the intestinal coats healed (alluded to by Moynihan later). According to Barbat (11), the button pushed all the tissues out of its grasp except the submucosa and peritoneum.

Senn (12, 13), in 1893, wrote: "Halsted's advice to include in the stitches the firm fibers of this submucosa, is important and should

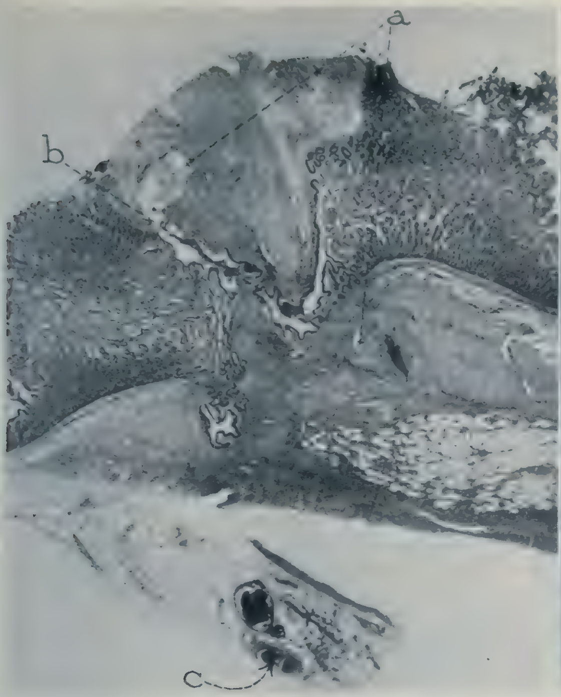

Fig. 3. Nine day joint. *a*, silk loop; *b*, ulcer closing; *c*, vasæ rectæ uniting.

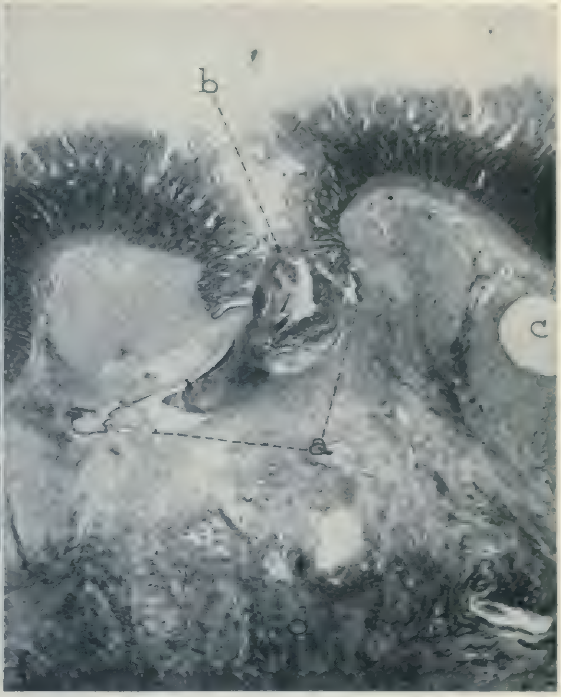

Fig. 4. Sixty-one day joint—delayed union. *a*, limits of epithelium closing over; *b*, pyramid of exudate; *c*, silk cavity; *d*, dense scar tissue.

never be ignored"; and speaking of the Czerny-Lembert method said, "the inner stitches ulcerate into the bowel; the outer ones become encysted."

Edmunds and Ballance (14) of the Brown Institution, London, in 1896, quoted Lister's description of the isolation process, and showed that the sliding of the mucous membrane over the muscles took place between the submucosa and muscularis. They used both Lembert and Halsted stitches and proved that both sloughed to the lumen of the bowel. They thought it remarkable that in Maunsell's operation the circular suture of through-and-through unabsorbable material should leave fewer signs, in a given time, than the Lembert stitches in the longitudinal slit.

Spalteholz (16), in 1897, described the connective-tissue framework of the mucous membrane of the small intestine of the dog as consisting of a dense network of reticulated, collagenic and elastic tissue.

H. A. Kelly (17), in 1898, wrote that "the most valuable contribution which has yet been made to intestinal surgery is the demonstration by Dr. W. S. Halsted of the fact that the essential feature in any suturing or anastomotic operation is the employment of the submucous intestinal coat," and referred to its other applications by comparing the relative thicknesses of the submucosa in the large and small intestines as being of the ratio of 4 to 1 respectively, and by utilizing the sigmoid in walling off pelvic infections by placing it around the brim of the pelvis.

OBSERVATIONS AND EXPERIMENTS

In an attempt to secure for the students in the College of Medicine of the University of Illinois the appreciation of the submucosa in experiments in intestinal work, as well as to investigate its physical properties, its study and isolation were begun.

In the first place, everything made from the submucosa was secured from the packing house, as catgut, tennis-racquet and violin strings, and Cargile membrane (derived from the trachea and now called Allison-Brooks

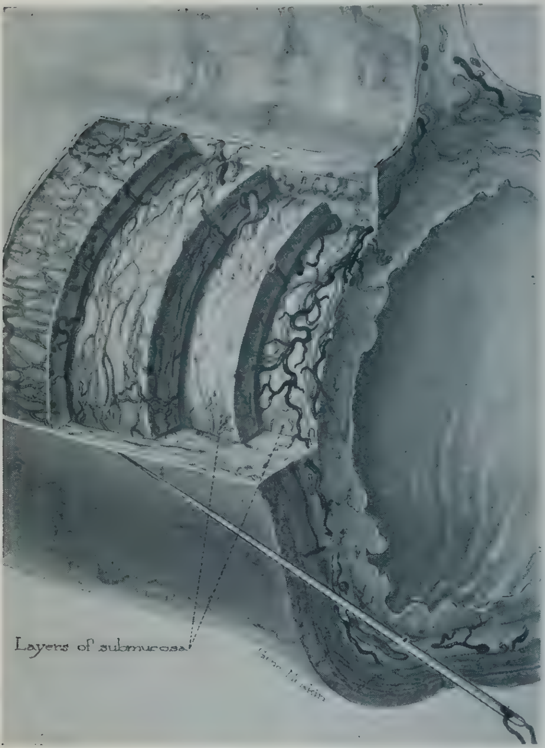

Fig. 5. The coats in echelon with needle applied for the Lembert stitch and controlling hæmorrhage.

membrane). The manufacture of most of the articles was observed. This gave an entirely different view of the relative strength of the various layers of the bowel wall and it was readily seen why some stitches pulled out, and why care was necessary in taking the Lembert stitch.

The submucosa was studied in six ways:

1. Raw bowels. Sections of beef bowels were used in practicing the fundamental stitches and in making unions. Fortunately, at one of these periods sausage casings were sent, and the students were obliged to familiarize themselves with this vital layer—the submucosa.

2. Dogs. Experiments on dogs were made as follows: The submucosa was exposed by removing the overlying coats at the pylorus and at various places in the small bowel, the muscles being the easier detached as the ileum was approached.

3. Excursions. The class was taken to the Chicago Stockyards, for it is only from watching the packing-house prepare sausage casings and catgut that this tissue assumes its identity. There, after macerating the bowel in water for a time, it is pulled through the "slimer," which removes mucosa, muscles and peritoneum, leaving the submucosa, a slender translucent shred, or a casing for sausage (Fig. 1). That it is a permanent layer may be seen as it deviates under a blood vessel as a subway runs under a river, leaving the course of the vessel outlined as it branches toward the antemesenteric border.

It will prove highly instructive, as well as a time-saving process, for the surgeon to visit an abattoir and see the bowel macerated and stripped. Afterward, he will not allow the submucosa to slip from his line of suturing, as sometimes happens in practice on animals. The unpleasantness of this work in their attainment of asepsis has kept surgeons from this study heretofore. They should see (1) the maceration and stripping of the muscularis and mucosa; (2) the distention of casings with water; and (3) the spinning of the submucosal strands into catgut.

4. At operations. Dr. Alfred A. Strauss in demonstrating operations for pyloric stenosis, pyloric closure, and repair of ulcers, made the following manipulations: (1) He stripped the muscularis from the submucosa in very much the same manner as one would peel a banana; (2) he threw a band of rectus fascia between the submucosa and muscularis at any point desired for a closure of the lumen, at the pylorus or elsewhere; (3) he even patched with rectus fascia the opening made by a gastric or duodenal ulcer. The submucosa formed the buttress of his suture spans. In all this, the thing that impressed me was the way the submucosa stood out as the "skeleton" of the bowel structure. The conclusion followed that this tissue was not sufficiently emphasized in abdominal surgery.

5. Microscopic comparisons. Histological sections of sheep's gut were compared with its product, catgut, teased out and stained; that of normal hog gut with its product, sausage casing, stained, noticing that in the hog gut slide the submucosa almost loses its identity as a layer under ordinary staining methods.

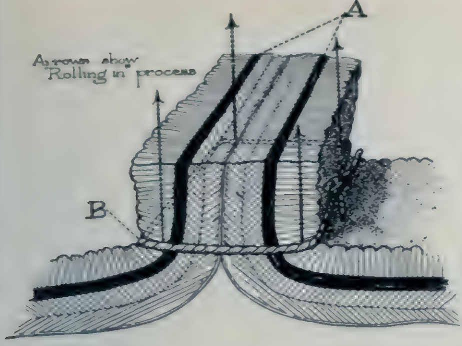

Fig. 6. Typical stitch with submucosa emphasized. Diagrammatic. Showing the "rolling-in" process.

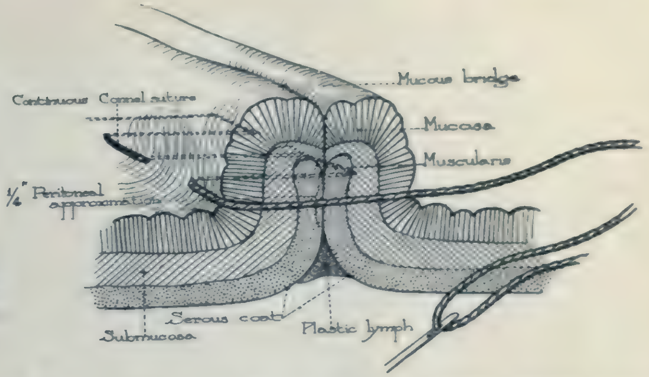

Fig. 7. The continuous Connell suture, showing grasp of submucosa and approximation of peritoneum.

6. Regeneration of layers. To verify the permanency of its tissue by the slowness of its regeneration, junctions of the jejunum in the dog were made. Sections were made parallel to the lumen of the bowel, the fate of the silk sutures noted over periods of 5, 7, 9, 31, 59, and 61 days and the regeneration of layers traced. The silk fibers swelled up and yielded easily to the sectioning knife in any plane. The silk particles of some of the later joints seemed hard and brittle, taking the stain badly, and breaking up on the edge of the knife. The silk always acted as a foreign body as shown by its migration toward the mucous membrane to be cast off (Fig. 2).

The silk loop was almost sloughed out in 5 days, the scar tissue holding the joint, but fragments of silk were found as late as 31 days. In the 59 day joint the site could only be identified microscopically by a few inflammatory cells, and by one layer of the muscularis mucosæ being somewhat thickened. Of course, the submucosa was completely regenerated (Figs. 3 and 4).

PROPERTIES OF SUBMUCOSA

From these and other sources the submucosa may be described as follows: isolated, it appears as white translucent strands.

Histology. Carey (18) tells us that the submucosa is arranged in two spirals, the inner one making a complete turn in 0.5 to 1 millimeter and the outer one in from 4 to 10 millimeters. The submucosa takes only the diffuse stain, which accounts for the fact that the student loses sight of its importance surgically. He should recall from histology white fibrous connective tissue; and then examine the drawings of reticulated tissue, for, doubtless, the makeup of the transclucent strands is composed of (1) the reticulated, collagenic and elastic tissue of the connective tissue framework of the mucous membrane, (2) the muscularis mucosæ, and (3) the submucous fibrous and elastic tissues.

Strength. Goldbeaters' skin, a derivative of the peritoneum which is a much thinner structure than the submucosa, in books of 1,000 leaves making 1 inch in thickness, withstands the beating of a 6 to 16 pound hammer 10 hours a week for a period of 2 years—a test of its permanency—yet it will tear in one direction as easily as paper.

Thickness. The tracheal submucosa (weasand) varies from one-sixteenth to one-hundredths of an inch—the thinnest Cargile membrane. It would probably grade for the different organs as follows: trachea, large intestine, small intestine, ureter, fallopian tube, pelvis of kidney, gall bladder, and gall ducts.

Resistance to the needle. As the needle engages it in taking the Lembert stitch, a point ahead of the needle where the blood is pressed out of the muscularis and serosa forms the "white ischæmic spot." It should give the resistance of rubber dam. A *pause* should be made to get these tests in taking the Lembert stitch, and the needle not be rapidly thrust through the bowel, as a Hagedorn is entered through muscle or fascia. Practice only will educate the operator as to when and how his needle penetrates the submucosa (Fig. 5).

Permeability. a. To gases. Goldbeaters' skin is the only known membrane that is impermeable to hydrogen gas for any length of time; hence its use in airships. That the bowel wall has such powers is evidenced by its being capable of retaining gas under the enormous distention of tympanites in certain cases of obstruction.

b. To liquids. Normal salt solution easily passes by osmosis through the sausage casing.

c. To bacteria. The membrane is not permeable to most bacteria. Bacteriologists tell us that the lymph glands on the mucosal side are practically always infected, and the fact that peritonitis is not more frequent proves what a barrier the submucosa is. Rammstedt, in his operation for congenital pyloric stenosis, took a forward step when he relied upon the submucosa to keep back the bacteria from the peritoneal cavity with the assistance only of the oversewed omentum.

d. To toxins. The membrane is not permeable to toxins of large molecular size. It will retain the ptomaines in an obstructed loop, or in ptomaine poisoning, and even fatal cases are accompanied by a very tardy development of peritonitis. That it acts as an obstruction to drainage is shown by the more frequent practice of opening infected loops in obstruction. Sala (19) had 7 such cases. And to avoid such a condition, surgeons, fearing the effect of such retention and pressure on the junctions, are opening the bowel to the exterior below (Hohlen, 20). Where paresis of the bowel can be demonstrated, it seems that the making of an artificial fistula is indicated. Natural fistulæ are certainly rare compared with the number of cases of peritonitis.

The function of the submucosa is, therefore, three-fold: it is (1) connective (2) supportive, the "skeleton," and (3) retentive. These functions are recognized by the resistance to pathological processes, the rarity of fistulæ, and the slowness of regeneration. It is retentive to gases, bacteria, and toxins, as in obstruction from tuberculous peritonitis with enormous distention, or to ptomaines developed from poisoning or from an obstructed loop.

Applying this impermeability to the walling-off process, Privat (21), in 1846, not being satisfied with Lembert's method closed four perforations of the intestine by suture. When this failed, he secured closure by placing an adjacent healthy loop against each perforation, and concluded that that was a better method than suturing.

The absence of the submucosa in the uterine mucous membrane is a factor in the explanation of the immunity of the pelvic peritoneum.

RÉSUMÉ

Returning to the part played by the submucosa in intestinal suturing, Figure 6 represents diagrammatically a unit or typical stitch of the Connell mattress suture. Lifting up the everted mucosa and submucosa, the latter presents as a pale, shining membrane like the raw side of leather (landmark). The needle penetrates the united coats, catches the retracted muscles, secures peritoneal approximation with the opposite side, picks up its submucosa, passes over a space of mucous membrane, and returns to near the point of entrance, and is tied. The connective tissues form two splints: *a*, layers of submucosa, and a bandage, *b*, (suture material) compressing the soft yielding tissues, the glandular mucosa, the vascular muscles, and peritoneum. (Fig. 7).

The method of union is very simple as shown by Moynihan (22) as follows: "But I still think that the great virtue of the button (Murphy) was not in its own use, but in the convincing demonstration it gave to the essential simplicity of the process of visceral union. By using the button we learned how safely and how rapidly the peritoneal junction took place; there was no need, it was now perfectly evident, for the hundreds of stitches that all surgeons were using. Firm, even approximation for a very few days would lead, the button showed beyond a doubt, to permanent and secure fusion of the apposed viscera."

The intestine is very vascular as a tissue, with free longitudinal anastomosis in the submucosal vessels. Within an hour the peritoneal junction is covered with plastic lymph, which the broken circulation throws out as an expression of the injury suffered. The healing process has begun. This plastic lymph should not be disturbed by manipulations, nor allowed to be liquefied by bacteria from the mucosa. It will bury the stitches, if they are pulled taut, from the peritoneal surface, and no "capillarity" can take place, the stitch (foreign body) being immediately on its way to the mucosa to slough out. This "rolling-in" process of sloughing of suture material is complete, for the most part in 5 days (Figs. 2 and 6) which might be called the time of repair.

All recent bowel operations show that the importance of this coat is appreciated. This is especially true regarding the Rammstedt (23) operation for congenital pyloric stenosis, the operations upon small ducts—anastomosis of the ureter, and anastomosis and transplantation of gall ducts—which were done in the experimental laboratory a long time before surgery adopted them, and recently, the aseptic operations for the resection of bowel by Collins (24), and Horine (25). Suturing over clamps is inconceivable without a knowledge of the integrity of the submucosa. As Halsted applied the method upon the heavy submucosa of the rectum and sigmoid, areas in which it is impossible to use the Connell suture because of their inaccessibility, there seems to be no reason why it should not be applied to the bowel high up.

CONCLUSIONS

1. In Lembert's time the principle was established that "raw tissues of like nature will unite if held approximated long enough" and union was secured by approximating the peritoneal coats.

2. Halsted showed that all intestinal suturing must be with the submucosa as the basis (the skeleton).

3. Students should see this structure isolated; they take better stitches afterward.

4. The submucosa must be taken into consideration in regard to drainage of bacteria and toxins from obstructed loops of bowel; and in regard to making and closing fistulæ. It may be utilized to prevent extension of peritonitis by walling off areas.

5. All through-and-through and most Lembert stitches slough to the lumen of the bowel; a few encyst at the serosa, being cut off by the action of the muscular coats.

6. The tendency to throw off a foreign body by sloughing out is stronger than the tendency to absorb it.

7. Visceral union is a matter of sloughing of suture material, and of absorbing superfluous tissue, and is accomplished in a few days.

8. From the study of this tissue there has been evolved the aseptic resection of bowel by Halsted and others.

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DISCUSSION

Dr. A. J. Ochsner: This scholarly paper of Dr. Graham's deserves careful consideration because it represents an enormous amount of careful work, and it is the first paper since the one written by Dr. Halsted which emphasizes the importance of the submucous connective tissue layer of the alimentary tube as regards its importance in intestinal surgery.

Since the remarkable work by Lembert, over one hundred years ago, published, I think, in 1812, which described the first real successful method of intestinal suture, every successful method which has been described was successful because it utilized the submucous connective tissue layer; and the success depended entirely upon the proper use of this tissue. But sufficient stress has not been laid upon this fact, and for this reason Dr. Graham's paper should be thoroughly appreciated.

Dr. Alfred A. Strauss: I think that Dr. Graham has called the attention of the profession to a very important and very vital point in gastrointestinal surgery, namely, the importance that the submucosa plays in forming a union that is safe from leakage.

I think the practical point of application of this interesting work that Dr. Graham has done is that when the mucosa and submucosa are sutured as one layer the muscular layer and peritoneum as another layer, the inner suture, which is composed of mucosa and submucosa, constitutes the vital parts of the strength of the bowel. There is also an exudate and serum poured out between the inner layer and outer layer of sutures which acts as a double safeguard as to leakage. Suturing these layers distinctly does not cut off the important blood supply that is present between the submucosa and muscularis, while in those types of sutures where the suture dips down through all the layers to the submucosa, there is bound to be a strangulation of the blood supply and more of an anæmic necrosis which cuts through and is more apt to produce leakage.

I have demonstrated from animal experiments that the best suture for getting perfect approximation and a good union without any scar formation is a simple over and over suture, the inner one catching the mucosa and submucosa slightly on the slant so as to catch a large surface of the submucosa and practically holds the mucosa edge to edge. The importance of this stitch is that it is the strongest layer of all the coats. The seromuscular suture can also be sutured edge to edge just as you close the skin by an over and over suture, in the type of a Lembert suture, which simply inverts the muscularis very slightly.

Dr. Graham (closing): In a resection (amputation) of a portion of bowel, the major injury to the organism, and the one to which expression is given immediately, is that to the circulation. The blood is thrown against the closed ends of the arteries, the serum exudes and clots, forming the plastic exudate. Lembert took advantage of this *immediate* exudate in approximating the peritoneal coats to which it would adhere. With the sealing power of this exudate any stitch, securing the submucosa and firm approximation of the peritoneum, will obtain a tight joint.

SUBMUCOSA DISSECTOR

By A. J. GRAHAM, M.D., Chicago

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SUBMUCOSA DISSECTOR

By A. J. GRAHAM, M.D., Chicago

THIS instrument was devised to do exact dissection in those instances in which habit has led the operator to use the end of the scalpel handle or scissors, which instruments, obviously, are not uniform in size, shape, or degree of sharpness.

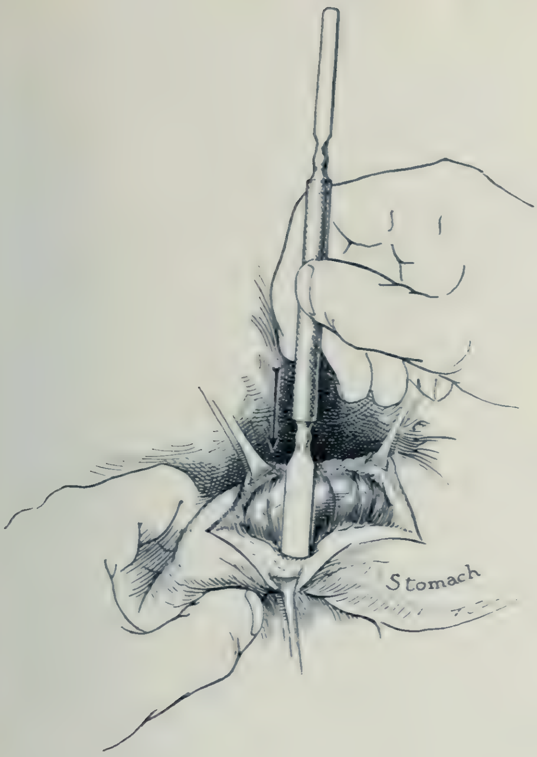
Point *A* (small end) is for use in splitting the bowel wall.

The cleavage in this instance takes place in the loosest part of the submucosa just against the circular muscular layer, as here also occurs "the sliding of coats" in protrusion of the mucous membrane, when the bowel is sectioned. Point *A* is designed to break these layers apart without cutting and thus causes the least hæmorrhage (congenital pyloric stenosis, enterostomy).

Other uses of the instrument: It may be used to lift the peritoneum from any structure, as in exposing the gall-ducts, or ureter, or in separating adhesions.

Point *B* (large end) is beveled and the long edge, properly dulled, is directed against the leather-like submucosa and thus scrapes it clean. Instances of this use are (1) the shoving off of the pyloric sphincter muscle in congenital pyloric stenosis; (2) the clearing of the gall bladder or liver and connective tissue in cholecystectomy; and (3) the separation of the peritoneum and bladder from the uterus when directed against the uterine muscle in hysterectomy.

NOTE.—These instruments are inspected before distribution to insure the proper degree of dulness, so that they will *scrape*, but not cut the tissues. (See "Isolation of Submucosa in Intestinal Surgery," Surg., Gynec. & Obst., xxxviii, 259.)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